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WHEN THE CANAL BARGE TAKES THE ELEVATOR TO SCALE THE HILLS [See page 18]

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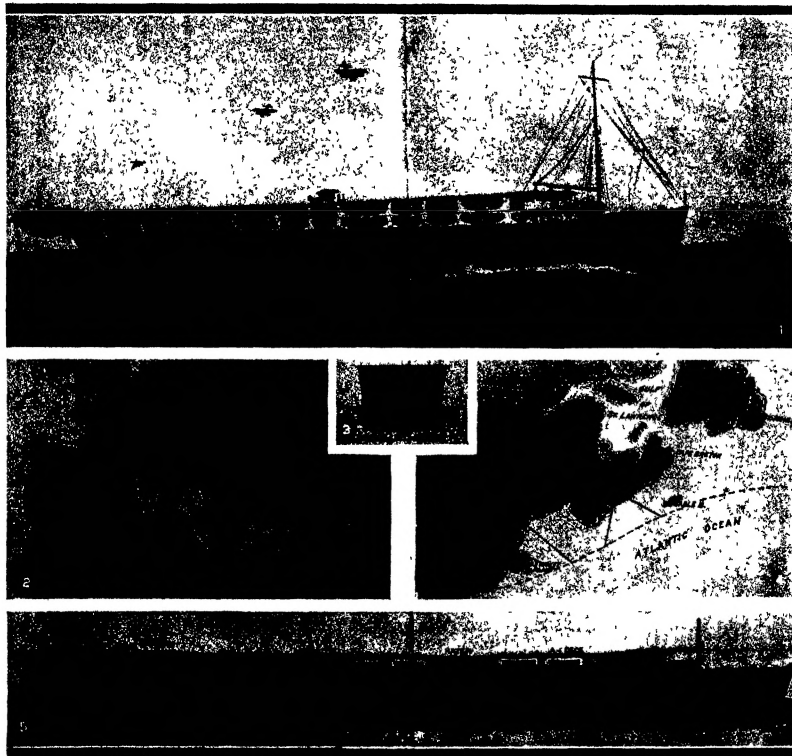
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SEVENTY-NINTH YEAR

SCIENTIFIC AMERICAN

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NEW YORK, JULY, 1923



1. Postpaid aircraft-carrying mail steamer in mid-Atlantic. 2. Land's end to ship, showing the dirigible. 3. Close-up of ship's hull, showing the dirigible. 4. Map of the Atlantic Ocean showing the flight path of the dirigible. 5. Longitudinal section showing flying deck, passenger accommodations, airplane hangar, mail and boiler rooms with stacks that discharge exhaust.

Ocean travel by combined steamship and airplane (see page 16 for description)

Trapping the Burglar

Clever Devices Put Forward by Inventive Genius for Catching the Prowler at His Work

By Edward H. Smith

EARLY IN 1898, His Highness, the Duke of Brunswick, hired a valet. As was his custom, the deposed Charles Frederick Augustus William exercised both care and caution in the choice of this new body servant. He spent many weeks over the problem and finally settled upon one, Shaw, a Britisher who had apparently served several noble English houses and once away with the most famous testaments, all of which the duke's German had examined with anxious eye. Shaw arrived in April, came to terms with his new master and was installed.

The circumstance with which the duke moved was natural. On his detourment in 1890, he had removed to a great old house in Paris, carrying with him a treasure of about three million dollars in jewels and gold. His collection was famous and the refugee prince understood that he and his blood were the objective of constant plots among European emperors. Accordingly, his Paris house was most strongly and marvelously fitted with defenses in the nature of special locks and bolts, iron doors, watchmen and alarm contrivances. Every European inventor of means of anti-burglar devices found a ready customer in the duke, and certainly no house on the continent could show curious and elaborate means to match those to be found in the duke's quarters.

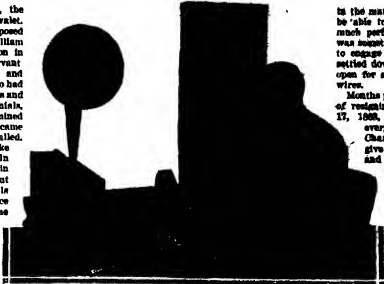
The store of jewels was kept in a huge iron safe of French or German make, and was in a specially constructed alcove opening from the bedroom—recess which might now be called a vault. This alcove was reached from the bedroom with perfects of intricate design. Once this door was got open, there stood the vast safe, again locked with a series of contrivances of particular interest here—defended by not one but three sets of arrangements. If any rash robber attempted to open the door of the safe without the proper keys and the secret of handling them so as not to release the triggers, he was certain to receive the fire of three formidable batteries of revolvers and shot gun—enough to dispatch an elephant!

No one but the duke himself had the keys and only he understood the complete intricacies of his defenses. As a rule, he permitted no one else to be present in his bedroom when he opened the doors of the vault and safe, as he did at intervals to glance over his treasures with merely emotion or to display some of his gems to friends or to an autograph man.

Such precautions had been in force more than 30 years. There had been plots and attempts without number, including one abortive attack on the duke's life, which he interpreted as an effort to get at his possessions. Now, however, he had himself opened the way to his hoard. Shaw, the new valet, was a notable British professional burglar. His references had all been forged and the triple-caution Brunswick prince had fallen before a trick which still succeeds in putting criminals into the households of the rich.

Shaw put in the first few months of his service getting the confidence of his master, a thing not too lightly accomplished. But once the fugitive prowler had been well beguiled, he trusted Shaw even to the extent of admitting that he actually owned some jewelry and that it was somewhere about the house. The servant had, to be sure, discovered the true door of the vault on his first day in the house, obviously hidden as it was behind heavy velvet portieres near the head of the bed.

The new valet used the first opportunity for reconnaissance. When his master was gone and the other servants were elsewhere, he threw aside the trues and inspected the locks of the vault door. Two of them, he saw, could be opened with great facility. The other was of a well known make and he consequently anticipated ease in opening it by his thorough confidence in the burglar's previous accomplishments, and the next time the duke left the house his



Even the radio telephone has been utilized in ransacking down the thief. Here is how the New York Police Department broadcasts an alarm to every party.

valet promptly opened the vault door and beheld the precious aspect of the safe. Not only was it protected by the battery of shooting irons, he found in his surprise that it was electrically wired, surely the first strong-box in Europe to be so equipped.

This wiring was never slightly less compared to modern installations of the type. It is, however, for more than one reason, worth attention. The electric wire in the duke's safe led to bells in various parts of the house, which would begin to clang the moment any one tried to force the safe door or tamper with its locks. This was a revolutionary idea and the only part of the duke's defenses with which the burglar had not been familiar from the beginning.

Just how far beyond the imagination of even the electric bell was at this time may be seen from the experience of Mr. Edwin Holmes, the originator of the well known central office burglar alarm system which bears his name. Holmes's device was originally no more than a mechanism by which an alarm bell was sounded in the bedroom of the user or in some other part of the house distant from the door or window being attacked by the burglar. Only a few years before the entrance of the Duke of Brunswick, Mr. Holmes had been forced to go about in Boston and New York with

in the matter of alarm mechanisms and had hoped to be able to disconcert those of the Duke without too much pain and trouble. But this new electric ring was something he had never imagined of, and was loath to engage. However, it did not detain him. Instead he settled down to watch developments and keep his eyes open for a chance to discover the level of the duke's wires.

Months passed without result and Shaw was thinking of returning and returning to London. On December 17, 1898, however, the unexpected circumstances of error had played into his hands. The quondam Charles Frederick Augustus, etc., had decided to give a certain lady a few jewels for Christmas and had summoned a jeweler to consult with him about putting the gems into fresh settings. Preparatory to the goldsmith's arrival, the duke opened his vault and the door of the safe. Then he sat about, chess and writing. An accident had befallen the jeweler and he did not appear. After waiting for an hour, the duke impatiently closed and locked the vault door without having taken the trouble to replace the door of the safe and put his safe-gear and alarm into business order. So he quit the house, leaving a cautious message for the jeweler who was to be commended to return that evening.

Shaw, of course, seized the golden opportunity. He opened the vault door and took the jewels with what seemed most readily salable of the duke's treasures and fled. But he was indolent enough to write letters and make a note of his booty. Beside him with the duke's diamonds of Brunswick to open this account of his adventures.

I choose the tale of His Highness of Brunswick to open this account of his adventures, which now have sought to catch burglars because it reflects the transition from primitive arrangements of this sort to modern appliances. The safe-gear with which he had armed his safe were almost as old a contrivance as firearms themselves, the electric wires were and are as modern as anything save the wireless.

In this generation we hardly think of a burglar alarm or thief trap without electricity. Once not could not imagine such devices as made effective ways by means of gunpowder. But the man trap is, of course, much older than electricity or explosives. Primitive African tribes use pitfalls and snares against their enemies in battle and against invaders by thieves of their lands and cultivated lands. In such tricks were first employed back in paleolithic times in hunting game. We find the modern applications of these savage ideas in the traps which were arranged against poachers in Europe and in this country within memory.

The case of Louis XIV of France, one of the royal sons was equipped with a bomb, strangled to explode in case the structure were forced open. That is, it blew up a trusted servant instead of a burglar. Accidents of this sort have gradually disappeared from the use of the set gun, which used to be pinned behind the door of many an humble chicken coop and goods cellar. I recall such an incident from my own boyhood. A further in the vicinity had repeatedly been noticed by the duke's valet, who had decided to end his depredations by means of a loaded shot-gun set up in his stable, and pulled at the trigger of this device of this sort of a gun, which pulled the trigger when the door was pulled open. The burglar then saw the light and fled. The duke then saw the light and fled. The duke then saw the light and fled.



A home-made set-gun for garage use, which would probably put a burglar down when the burglar's nose.

a miniature model of his installation in case he should be disturbed. He was not, however, so well situated elsewhere. No one would have been able to get into his safe. He was not, however, so well situated elsewhere. No one would have been able to get into his safe. He was not, however, so well situated elsewhere. No one would have been able to get into his safe.

Mr. Shaw, valet and burglar, decided the door of the duke's vault with means of delicate work could set off the safe door, right enough. Also, he was an expert

every man's business in the matter of the duke's vault with means of delicate work could set off the safe door, right enough. Also, he was an expert

Building the World's Largest Monolith

A Word Regarding the Far-Reaching Significance of Wilson Dam to Navigation and Industry

By Littell McClure



THE MOST significant effort in construction undertaken by the Government since building the Panama Canal is the mammoth fashioning of Wilson Dam across the Tennessee River at the foot of Muscle Shoals in a rich spot Alabama. Under direction of War Department engineers, forces of men, many of whom are trained in dam building, are pushing the work night and day on this the largest concrete form in the world. Wilson Dam will be not only the most massive structure of its kind but it will be the greatest hydro-electric installation yet achieved.

The photographs reproduced herewith are the first showing the progress of the Government's effort. At present work is in five main divisions. First there are the lock chambers for navigation over the dam at the north end. Just beyond these rises the short non-overflow section. Across the two channels of the river and the island between them extends the main spill way division. At the south end against high banks stands the half-insulated powerhouse on which construction is rapidly going forward. Then driven into the south banks for a quarter of a mile will be the high crest wall.

The two locks along the north side will have a lift of 45 feet 6 inches each. These locks like all the other equipment on Wilson Dam will be electrically operated by current from the gen.

erators. Some idea of their insensiveness may be gained from the fact that the lock gates will weigh 17,000 tons and each of the six crest gates will weigh 81 tons. Orders will soon be placed with large manufacturing concerns for some of this machinery, of which 4,000 horsepower, appropriated \$10,000,000. This cost is in addition to that for turbines, generators and much of the other electrical equipment. When completed, Wilson Dam will be 500 feet long, 101 feet wide at foundation and will lift its superstructure nearly 125 feet above the river.

Let us bring into our
 balance such a month
 of the year as the
 few sometimes reach
 500,000 rails, free a second
 and all phases of the work must
 be done with speed, blasting and excavating
 being in materials for making concrete buildings
 drawing forms transporting concrete to these forms
 and the final pouring. To consolidate these factors in
 the few months of the year, 27 miles of such material
 does boats and barge a number of electrical cranes
 some of rock drills three huge crushing and mixing
 plants 30 locomotives and more than 200 cars and
 1000 men.

The effort is truly gigantic and in some phases quite
 spectacular both as to engineering and construction.
 This may be realized when one considers that Wilkinson
 is the largest city in the world, and that the city of
 as the Roosevelt Dam in Arizona, and that it will be
 81,000 cubic yards larger than the Aswan Dam in
 Egypt—at present the giant among the world's rivers.

There are few precedents to guide the various phases of the work for the reason that this is the most massive dam ever undertaken and because it is being built in a limestone country where fissures may occur in the rock strata. While the general principles of gravity-dam construction are well known, Wilson Dam, like the Panama Canal is a problem unto itself and in an engineering sense a fascinating one.

The first natural enemy to be checked mated is upward pressure—the upward thrust of any water that may seep under the foundations. At the start, of course, the riverbed was exhaustively tested by diamond drilling and hydraulic pressure. Then the solid rock was

blasted out 16 feet deep across the stream. Into this channel the concrete foundations of the dam were 'toed' making them virtually monolithic with the natural rock.

Throughout the length of the dam a tunnel is being constructed through the foundations close to the riverbed. From this tunnel 6-inch holes are drilled far down into the limestone beneath. There is one of these every 23 feet from bank to bank of the river. If upward pressure occurs from seepage these holes will act as relief valves, taking up the water and releasing it through pipes into the river below. And through them concrete will be shot down and driven under air pressure into any crevices through the rock, thus permanently sealing them.

Some of the most interesting work is that on the great powerhouse that will be 1184 feet long. The design of the pump-turbine photographs were taken, workmen were busily tearing up the forms and revealing the cut-outs of the first penstocks. The volume of water that will surge through these penstocks to the turbines may be envisioned when one realizes that each penstock is 12 feet 4 inches wide and 15 feet 10 inches high. There will be 54 of these—three to each turbine—and they will have a capacity of 62,000 cubic feet of water per second.

Four of the 18 turbines will have a generating ca



Smooth and beautiful work on the main spillway section, showing the special illuminated boulevard along the top of the Wilson Dam

lately of 90,000 horsepower each. The other 14 will develop 86,000 horsepower each. The total maximum installation will be for 624,000 horsepower. And this energy harnessed from the river's flow and pressure will be supplemented by the 100,000 horsepower steam plant built by the Government that stands on the banks of the river a mile below the dam.

A fine problem in engineering and construction is presented in cementing the powerhouse forewall into the limestone bluffs by means of a great core wall 1000 feet long. This core wall will be as high as the dam itself, seven feet thick at the base and will taper to five feet at the top. This immense, inviolable water barrier, deep down in the rock under the earth will for all time prevent any possible seepage around the power house entrance of the dam.

Before Wilson Dam is finished almost 1,000,000 yards of earth and stone will have been excavated from banks and river bed and 1,350,000 yards of concrete will have been poured. The work is under immediate direction of Colonel W. J. Barden, of the United States Army, and Government engineers associated with him. There will be no letup night or day until the project is completed at a cost of approximately \$50,000,000.

A race with Nature is immediately ahead in building across the swift southern channel a very high cofferdam nearly 700 feet long. As this article is written the engineers are concentrating every possible force at this cofferdam. Their determination is to have it finished by late summer as summer and autumn constitute the low-water period in the Tennessee Valley. It is this

cofferdam is completed on schedule, entirely diverting the south channel during low water, then the dam's foundations can here be blasted out and concrete pouring will raise this section of the structure to sufficient height for work to continue on it steadily through the high water period of next winter.

A bascule bridge spanning the locks at the north end, will join a concrete arch bridge over the main structure and by the power house. These bridges will have a boulevard surface and will carry double tracks for electric cars. The boulevard will be a link in three national highways—the Jackson Highway, from Chicago to New Orleans; the Lee Highway from the Eastern Seaboard to the Pacific Coast; and the Scenic Highway, from Jacksonville, Florida to Seattle, Washington.

Here and there the removal of the wood forms indicates the striking beauty and perfect uniformity of the work. When finished, Wilson's dam will be the most beautiful structure in America. Owing to the depth of the power pool, the water flowing over the crest will be clear. A magnificent view of the river will be attained and the boulevard will be swept with evenly distributed rays from reflectors sunk along the river margin. In the river below the dam, the illumination searchlights will be anchored. These fans-of-light will flood with brilliance the about waterways and the river banks, the apron and the voluminous clouds of tumultuous tail water swirling down from the turbines. The illumination is the idea of the architect, the architect back of this spectacular illumination is the lighting engineer. The illumination is the idea of the architect, the architect back of this spectacular illumination is the lighting engineer. The illumination is the idea of the architect, the architect back of this spectacular illumination is the lighting engineer.

valley rivers. In the coming years, the effort to make our swiftly flowing inland waters navigable will be the most significant. In industrial America is just beginning to catch a glimpse of the tremendous significance of navigation on mountain streams. Low-banked, slow-moving rivers like the Klamath are the

As to navigation—to say nothing of power—Wilson Dam marks a definite change of policy after a century of open-channel work, with canals, on our swiftest rivers. It is almost a certainty that in the future navigation and power dams with electrically operated locks will completely displace counter-current navigation through open channels and canals along power rivers flowing through regions of vast mineral resources.

Apart by itself Wilson Dam is not a power-and navigation unit. It is only the most important factor in the first comprehensive system of river improvements undertaken on the North American continent. This system includes plans for building power and navigation dams for nearly 400 miles on the Tennessee River—throughout the entire distance between Muscle Shoals and Knoxville.

Several of the larger tributaries already are under development by means of very high dams, and Government engineers have just started a regional power-and-minerals survey that will cost \$200,000. The cost of the

Uncle Sam's Agricultural Proving Grounds

The Federal Farms Where Problems of Vital Import to American Agriculture are Investigated

By Ralph Howard

DEPT. OF AGRICULTURE Md. 14 miles northeast of Washington is the site of the 475-acre national husbandry and dairy farm. The federal proving grounds are close enough to the scientific laboratory and office of the department to be readily accessible while far enough out in the country to be a regular dirt farmer's farm man aged and operated along practical lines. With its complete equipment and extensive quotas of live stock of the leading breeds and classes it can undertake investigations which are beyond the compass of the average state agricultural college and experiment station while still operating with the 48 experiment stations so that its findings may be verified in other sections of the country.

The Beltsville Experimental Farm was purchased and established ten years ago when the need for agricultural proving ground, as in all animal husbandry and dairying, was keenly evident. The dairy farm of 167 acres has a live stock population of 100 animals of the Holstein, Jersey and Guernsey breeds and is fully equipped and developed as a modern and progressive milk farm. The animal husbandry farm comprises 288 acres and houses substantial and serviceable buildings and improvements.

A visit to Beltsville Experimental Farm is as interesting and instructive as attendance at the business state fairs and live stock exhibitions. Practical investigations of vast economic importance to live stock farmers are constantly in progress at the government farm and usually so much is going on there that a visitor feels as though he had attended the biggest six ring circus under the sun. Here, too, the cattle, sheep, goats and poultry are being raised fed and studied in large numbers. The milk goats of the leading breeds are maintained in milk, herd which is maintained under most sanitary and practical conditions in a special stable that milk free of all odor and taint and more palatable and thirst quenching even than cow's milk is produced.

The goats are economical producers of milk which is especially well adapted for the feeding of young infants and invalids. Two milkings does can be fed and milk raised at less cost than the average family cow and they will produce 100 to 200 milk in the neighborhood of larger cities there always is opportunity for the establishment of a practical and profitable goat dairy.

Beltsville Farm really is a huge laboratory for the study of the principles and practice of husbandry. The farm has enough of everything. Polish China Duroe Jersey (better White and Turnworth) cows so that the spring pig crop usually runs well over 200 head. Poultry formation poultry of the leading breeds is maintained so that the annual crop of chickens is around 5000. The flock of broiler chickens which is handled entirely on the farm basis is without equal in the United States.

The problem of the eastern and southern farmer often is that of keeping his flock of sheep on a limited area. The government specialists have accomplished some extremely successful results in this respect at Beltsville. Four years ago the stock-carrying capacity of this field was limited to 44 ewes and 58 lambs. At present it supports 100 ewes and 100 lambs. No birds are retained for breeding operations which will not qualify under the American standard of perfection. Uncle Sam has established a state within a state, the majority of the females of which are producing 300 eggs or better during their pullet year. A majority of the individual males and females in the flock are

good enough in form, feather and fitness to win in any show which is held in the United States. Most of the work has been done with White Leghorns and Rhode Island Reds although many specimens of the other leading breeds and classes are also maintained. These birds have been trayed and therefore pedigreed for four generations. The poultry experts here have also developed a new breed of poultry which is more robust, larger and healthier and which produces as well as the Leghorn—better. These fowl have been obtained from judicious crossing of the English Dorking, White Leghorn and White Plymouth Rock breeds.

One of the outstanding achievements which has resulted from the swine breeding and feeding investigations at Beltsville has been the practical demonstration of the adaptability and value of fish meal as a protein-rich nutrient for use as a substitute for tankage and blood meal in the porker ration. Government tests at Beltsville showed that there was practically no difference in the feeding value of fish meal and tankage and that the use of the former ration gave somewhat tainted non-flavored pork. This frees the hog industry from the limitations imposed by the insufficient supply of tankage and plant tankage, and it thereby increases the importance to the swine-growing industry. Further more it leads to the efficient utilization of millions of tons of low grade and by products of the fishery along the Atlantic and Pacific coasts which heretofore have gone to waste.

PROBABLY the most of us who are not intimately familiar with the minute ramifications of the national Department of Agriculture visualize the branch of the Government merely as a group of beautiful and ornamental buildings, established by congressional enactment, for the completion of crop production and animal husbandry. Such a supposition is all right as far as it goes. But Uncle Sam as a farmer is not content to amuse all his fons from ponderous toms and voluminous brochures. He is an active, rugged "dirt" farmer who likes to get things up with the mellow earth and who prefers to learn at firsthand about the intricacies and peculiarities of his live stock. That is why he maintains the greatest agricultural proving grounds in the whole world—generally producers of facts and figures of immeasurable value to the swelling universe, in general, and to the American farmer and his folk, in particular. This is the story that Mr. Howard tells us here.—THE EDITOR

The animal husbandry experts ascertained that it cost between one and one-half and five cents more per pound to grow a pound of pork from four hog days than it did to develop a pound which were free from such parasites. It is such a simple matter to keep porkers free from such parasites and the government has been successful in this respect. If this experiment have carried a beneficial influence on hog management principles from coast to coast.

At the writing of this animal husbandry department is handling investigations of the causes of soft pork. Throughout the northern states hogs are fattened and marketed in the winter months and the results of the investigations are being made in the manufacture of soft, oily and greasy pork which does not keep well and which is the cause of much trouble to the consumer. These studies this problem will be of vital value to the hog growers who live north of the Mason and Dixon line.

There is also at Beltsville a study of swine and cattle feeding and breeding. Four state stations are at Lexington, Va. Manhattan, Kan., McIntosh, Miss., and Ames, Iowa. The studies are being carried on in their various locations. The work at Manhattan in cooperation with the state experiment station is to study the influence of the environment on the growth of the animal. This work has been under observation for two years and it is so anticipated that it will take about 12 years more to complete the study of the influence of the environment on the growth of the animal. The purpose of the study is to determine the correlation between the milking function and the growth of the animal. The study is being carried on in the milking tendency of the dam sows on the male and female parents and whether it is possible to develop and improve the milking character of the sow. This is in connection with the best feeding properties.

Along about 1907 when the activities of the Morgan horse was threatened, the Morgan Horse Farm of Ohio

was established at Middlebury, Va. for the rehabilitation and development of this splendid breed. At this writing, the farm covers 900 acres and has a horse population of 115 animals. The farm has resulted in a new base of life for the Morgan horse.

At Del Rio, Wyo., is another of Uncle Sam's horse farms where it will under the breeding of American utility horses—a native breed which the Department of Agriculture is trying to develop in cooperation with the Wyoming Experiment Station. For the most part, standard-bred mares are being used as foundation stock although some saddle, Morgan and Thoroughbred blood is also in evidence. The results of these breeding operations indicate that, ultimately the new and native breed will be permanently fixed in type.

The government sheep farm at Duffalo, Idaho covers 26,000 acres and now numbers over 5000 Ramboulets, Cheviots and Columbia sheep—the latter a new breed created and developed by the Department of Agriculture. By mating the ewes of one generation with those of the previous generation without ever returning to the use of the early foundation stock, the new breed has been permanently established in five years and is the first example of its kind which has been made in such a brief period. Also, at the Del Rio farm it has been ascertained that under range conditions as much wool is obtained from the breeds of sheep with hair faces as from those bearing wool from their faces to their loins. This sheep wool on their faces have been found to be more valuable than the wool on their faces because the snow and moisture would cling and freeze on their woolly

Extremely valuable work is also being done at Beltsville Farm along the line of animal husbandry. At the present time, the investigations have covered 11 generations of guinea pigs with the result that data of considerable importance have been obtained. It is proposed to continue these experiments, using larger animals more closely related to man and his needs than are the guinea pig and in this way to check the initial findings.

The Beltsville Dairy Farm is now engaged in one of the most important breeding experiments ever attempted. The purpose is to ascertain how best to develop a strain of cattle which will be uniformly high grade and which will be able to produce milk of the highest quality. It is anticipated that it will take from 10 to 20 years to bring this investigation to a conclusion. The results of the investigation are being kept in the Beltsville farm while some of the male progeny are being loaned to a few of the state experiment stations. The results of the work which already has run for two years.

Another investigation which promises more efficient results is the breeding of the turkey. The purpose is to determine which are the most productive of maximum milk flow. Some problems are very productive of maximum milk flow. The results of the investigation are being kept in the Beltsville farm while some of the male progeny are being loaned to a few of the state experiment stations. The results of the work which already has run for two years.

Other work being conducted at Beltsville is that it is probable to milk cows at three times daily without it being to waste the cows two or three times a day. The results of the investigation are being kept in the Beltsville farm while some of the male progeny are being loaned to a few of the state experiment stations. The results of the work which already has run for two years.

The government dairy industry has suffered a heavy loss of breeding stock from disease. The government is trying to develop a new breed of dairy cattle which will be able to produce milk of the highest quality. The results of the investigation are being kept in the Beltsville farm while some of the male progeny are being loaned to a few of the state experiment stations. The results of the work which already has run for two years.

It is under the dairy expert's eye that the most intimate contact with commercial dairy projects, Uncle Sam acts as supervising expert for the Grove City, Pa., creamery, which makes all its products and operates its factory according to methods recommended by the government. This permits of trying out under commercial conditions, the methods devised in the laboratory.

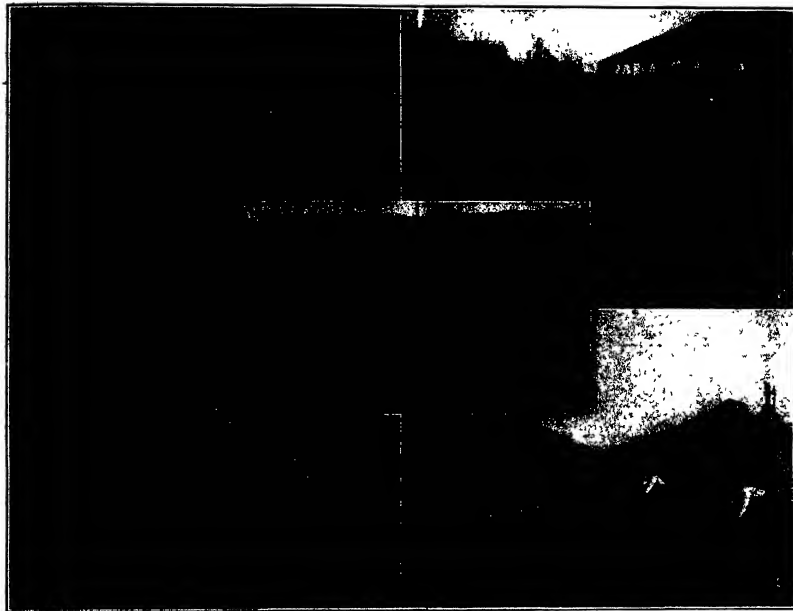
In addition to the Beltsville Dairy Farm, the Federal Dairy Division also operates 15 other cooperative dairy farms which range from 300 to 1000 acres in size and which are located all over the dairying country. Arlington Farm—the 400-acre cow and fruit proving grounds of the national government—abounds the Potomac River and at one time was a part of the Park Quanta Estate owned by George Washington. Just as Beltsville is

replete with the sweet potato and trucking industries alone have realized from the Arlington Farm experiments has more than repaid the Government for its establishment and maintenance.

From 500 to 700 varieties of apple trees, 300 varieties of grapes and 400 varieties of peaches are now being tested out. The vegetable trial grounds frequently contain as many as 1500 different varieties while the sweet potato plots not uncommonly are planted to 100 different kinds of yams. The place is so laid out that all the buildings are heated from a central plant while a huge water supply is piped to all parts of the grounds. Just to illustrate how important it is that the truck farmer use only specially selected seed of the best varieties, the experiences of a Maryland trucking region

phorus-depleted soils. This is one of the greatest fertilizer discoveries of the modern era as it eliminates the previous transportation problems which were associated with the shipment of phosphorus in the ground rock from long distances from the mines to the fields.

The investigations of the Bureau of Plant Industry which led to the definite conclusions that plant growth is dependent almost exclusively on the length of daylight to which it is exposed were also performed at Arlington Farm. These investigations have been produced by plant pathologists to be the most disavowed ever made by the Department of Agriculture. Uncle Sam's farming scientists are constantly on the hunt for new cereals, grapes and grasses adapted to the soils and climatic conditions in this country. As



1. All the plant's seeds produced at Beltsville are used in the laboratory production and testing of "foreign" strains. 2. An American manifestation of experimental crops at the Beltsville Farm. 3. The Federal Farm at Arlington is the home of the "F" in the "F" word. 4. The Gila and Pima Laboratory of the Department of Agriculture which at present is making a special investigation of cottonseed oil. 5. Dark-house laboratory at Arlington, where is studied the effect of light and dark on plant growth.

Clippings from the United States Government's Experimental Farms in Virginia

without equal throughout the entire world as an annual farm devoted to scientific investigations, so Arlington is without peer as a testing ground for crops, fruits, vegetables and practically all kinds of plants known to mankind, both in this country and abroad.

The farms consist of two types of soil—a heavy clay which is typical of the Coastal Plains region from Washington to Georgia and an alluvial soil typical of all the leading farming areas from Long Island to Florida. This means that every crop which can be produced in this country can also be produced at Arlington Farm and can also be tested over the belt under discussion, other conditions being equal. All the foreign fruits and cereals as well as the vegetables which have been acclimated to American conditions have been tested out at one time or another at Arlington Farm. The Farm is replete in storage and testing conditions where conditions in cold storage or other special cases can be obtained. In fact, the material

are illuminative. A storekeeper in this area sold large amounts of tomato seed to the neighboring farmers, accepting the word of the wholesaler from whom he purchased the seed that it was of good quality and adapted to use in the locality. The tomatoes were destined for use in the local canneries. When the plants began to ripen it was evident that all the tomatoes were yellow instead of red and practically valueless so far as canning operations were concerned. Hence due to the unreliable seed supply the chief cash crop of the entire locality was ruined at a time when red tomatoes of stouter size and excellence were selling for \$30 a ton. Federal control prevents such catastrophes.

The Bureau of Soils as a result of its experiments at Arlington Farm has recently devised a blast-furnace method of extracting phosphoric acid from phosphate rock so that the product can be bottled and sold commercially to farmers for the enriching of their soils.

As a result they are running trials every growing season of hundreds of crops of overseas origin. Through tests of this description samples of such crops as wheat, corn, grass, Rhodes grass, velvet beans, fetter, legum, cowpeas and over 1000 different varieties of soy beans have been introduced. In addition, experimental work is perpetually in progress in improving the types of the crops now in general use. The Government experts are always busy with the colossal task of finding new crops which are better adapted than those already in use for culture in certain sections of the country. In this way they introduced alfalfa to the western states, sorghums to the Southwest and the velvet bean to the Gulf Coast states. Despite that the general opinion among its men is to the effect that all the valuable farm crops worth working with have already been discovered there are thousands of plants of possible utility as producers of forage which as yet have never been studied.

Our Point of View

An Editorial Grievance

PSYCHIC research involves two major questions. The first is do the phenomena of mediumship occur in good faith, without fraud or trickery on the part of the medium? The second arises only after the affirmative answer is given to the first, granted that they do occur, what is their cause and modes of operation?

There is no ground for predicting, a priori, that the average mortal would outlive the questions, and be unable to discuss the one without dragging in the other. There is no ground for predicting that, of the numerous answers which might be suggested to the second question, any particular one would occupy such a large place in the public mind as to stand for the whole subject-matter of psychic research. Yet both these things have happened, and herein is our grievance alluded to above. With both the written and the spoken word, we have, after persistent effort, signally failed to improve upon our audience.

First, that one can deal with the occurrence of psychic phenomena without at all attacking their cause.

Second, that one can deal with their occurrence, and even come to a conclusion that they do occur, without giving any consideration to the question of individual survival of death, and without saying anything that in the least degree involves this question.

Third, and more recently, that our own psychic investigations has not so far had anything to do with spirits, spooks, phantas, or whatever you wish to call them, and that it is entirely possible for us to push it to conclusion without ever coming to have anything to do with spirits, with spiritism, or with the hypotheses of spirit survival and communication.

As an alternative to the belief that the world is in an incredibly illogical state, we have examined our own utterances on these points. They seem quite unambiguous—clear enough, beyond all doubt, to dispose of the thought that the rest of the world is sane, while we are unable to put a simple thought in intelligible words. Yet with negligible exceptions, the world goes right on linking us with the spirits, assuming inertia and wholeheartedly that our finding will necessarily be an endorsement or a repudiation of the spirits, that it is the spirits and nothing else that we are investigating.

For is this all. We believe we have made it sufficiently clear that the invasion of European psychic circles by one of our staff has no direct connection with our formal investigation here. This member of our staff has, we believe, made it plain very clearly that, while it is quite impossible for him to attend sessions of such varied character and so very ill incident with our bringing away some serious results in connection with the probabilities of the transcendent production of what he has seen, there remain impressions of the probabilities and nothing more. Yet he has been widely misrepresented as one who has staked his entire career on a function, who has demonstrated himself to be a credulous simpleton, and who has stated that what he saw convinced him of the reality of the phenomena.

Again, we have repeatedly pointed out that a fair-minded investigator may form no judgment, and have repeatedly set down the necessity for not leaning toward or against the phenomena. And the world goes right on honoring the one-half of this warning in the observance and the other half in the breach—insisting that the investigator must not admit in advance that maybe the phenomena exist, or that he agrees to give the privilege of insisting as vehemently as he pleases that they cannot and do not occur. Where it goes right on assuming that this is what we mean, and castigating us when we depart from this assumption.

Of course the reason for all this is that in the psychic field as in no other, most of us have our own violent preconceived notions. Any statement read or heard other than alternatives to our own preconceptions, with these options, or to twist it into disagreement and reject it. We should be vastly pleased if the world

would overcome its tendency to prejudge this subject. Failing this, we should be almost as well pleased if everybody would believe that, on this subject as on others, we speak after due thought for the sake of our utterance, and mean exactly what we say. Much misunderstanding would be avoided if this could be done, for we cannot possibly correct every published misstatement of our attitude, even if we could be sure that all such come to our attention.

Making Airplane Travel Safe

THE DISASTER on the Paris-London Airplane Service, when a machine burst into flame and fell, carrying six people to their death at Monreux, France, was a tragedy which is certain to emphasize in the minds of the public the danger of airplane travel. Nevertheless, we should guard against giving an exaggerated importance to this event by bearing in mind the many millions of miles that have been flown without any fatalities. We must keep our sense of proportion and consider the wonderful record of our aerial postal service and the fact that commercial service has to its credit the fact that no American company in 1922 made over 2000 flights and carried over 3000 passengers without an accident, and that the British service had a record for the same year of 690,000 miles flown without a fatal accident. And it will help our true judgment of the safety of airplane travel, if we bear in mind that, even today, it is a comparatively new art and that some of its major problems have yet to be solved. They will be solved and travel by air will become as safe as travel by train or ship. Statistics of travel show that the railroad train is so secure that a passenger runs less risk of accident than he does on the streets of any great city. We must not forget that the toll of injury and death in the days of early railroad development was both large and continuous. Rails would break, the track would spread, broken wheels and broken axles were common, bridges collapsed, and the frequent collisions took a frightful toll of human life.

Again, just as the time when the steamship companies were publishing perfectly correct statistics to show that the risk of travel by sea to the individual passenger had been reduced almost to zero, there came, in the last half of the last century, the sinking of the world's latest and largest steamship with the loss of some 1500 lives. Yet, large as was the death toll, when it came to be applied to the general average, the risk to the individual was small and but very slightly increased.

But after all is said and done, it cannot be denied that the problem before the builder is to make the airplane so safe that the passenger will take his seat in a commercial machine with confidence of that same confidence with which he starts upon a trip by rail or steamship. The growing tendency to use all metal construction suggests well for safe travel the Stinson Fire communicating from the engine to the gasoline tank is a terrible danger, but it becomes greatly intensified if the fire takes hold of the combustible material of a wood and fabric machine. Here we look for all-metal to be recognized as the sole safe use of commercial airplane construction. The possibility of a backblast from the engine will always be present with the current type of engine; but something surely can be done to prevent the flames from communicating with the gas tank; and it should be possible to mount the gas tank, so as to be the least likely to be damaged by the heat of the machine as freely as an airplane does a bomb.

The Flurry Over Naval Gun Elevation

THE FLURRY we read of lately in connection with a correspondent in London, giving the facts as to the elevation of British guns, will realize how purely artificial and thoroughly mistaken was the moral sentimentality so deeply ingrained in the press. It was indeed a veritable "tempest in a teapot." Mr. Bywater traces the development of the

mounting of naval guns from the days of Nelson to those of the great war, and we learn that, with the exception of the "Hood," the maximum elevation of the guns of the earlier vessels was not exceeded before 1914, and that on not a single ship has it been changed since then.

The interest in the subject of extreme range is due to the introduction of airplanes shortly after 1914, ten to twelve thousand yards was considered to be the extreme range at which engagements would take place. Spotting, or observing the fall of the shots, was done from the fire-control platform at the top of the mast, and beyond those ranges it became increasingly difficult to spot with serviceable accuracy. Hence the use of the airplanes, which enables the spotter, looking down from his lofty elevation, to note the fall of the shots and estimate, with accuracy, how far they are over or short of the target, even when the target is hull down and invisible from the firing ship.

Personally we do not believe that in actual battle a judicious Admiral will wish to fire away much of his limited amount of ammunition at ranges, where, even with the assistance of airplanes spotting, the chance of landing on the enemy will be small, and surety out of proportion to the amount of ammunition expended.

Let us consider the routine of airplane spotting, say at a range of 10,000 yards, and see how many seconds of time there is between the fall of one salvo and that of the next, as corrected by the spotter. After seeing the splash, a second or two is consumed by the aviator in determining its position in reference to the target; it takes an additional second to wireless this "spot" to the ship; a few more seconds to receive the message. Then, in the central station, the corrections must be applied, the change in elevation in guns determined, and the change applied to the sights, before another salvo is let go. Let us suppose that sixty seconds are consumed in all these operations. A salvo at 10,000 yards range will take about sixty two seconds to reach the target, so that between the time when the enemy ship perceives the fall of one salvo and notes the arrival of the next and corrected salvo, there will be an interval of two minutes and possibly more. If it changes his course as much as four points, or 40 degrees, as the German battleships did frequently in the battle of Jutland, and if his ship is a cruiser, he will have moved his ship some 2000 feet to the right or left of his course before the arrival of the corrected salvo, calculated upon the assumption that he will maintain his original course.

Upon these considerations we have based our estimate of the distance at which actions can be fought will be determined by the speed of the slowest ship and the range of the lightest gun, and not by the maximum range of the heaviest gun. We have based our estimate on a salvo by our table, of nearly 24,000 yards, and, although he had the most-gauge of the enemy, he preferred to open the fight at 16,000 to 18,000 yards.

A Notable Venture in Education

INTERESTED attention is being drawn to a system of education, which has been launched by Mr. Charles W. Eliot, President of Harvard University, at Antioch College, where the readers of the SCIENTIFIC AMERICAN will recognize as the author of the successful food-control scheme, known as the Mutual Conservation Project in Ohio. In the course of his twenty years' experience as a hydraulic engineer, Mr. Morgan has had in his employ some 3000 graduates of liberal colleges and technical schools, and a close acquaintance with the culture of these young men has done good to the extent to which their education and natural capabilities gave promise, had he made a more studious study of the men. This resulted in what has come to be known as the Antioch Plan, which Dr. Charles W. Eliot has called "the most far-reaching enterprise in education now going on in our country."

Fundamentally, the experiment that has been carried on at Antioch College for the past two years is the

Our Point of View

most and most ambitious of those schemes of education which combine with the college course a certain amount of practical outdoor work in the factory, or the office. But it differs from all its predecessors in the fact that whereas, hitherto, the outside work has been regarded as accessory or supplemental to the classroom, in the Antioch system it is a portion of equal importance, and the time of the student is divided equally between the two. Thus, study at the college and work in factory or office take place in five-week periods; each job being held by a pair of students who alternate between the study and the shop in five-week shifts.

The fundamental aim is to secure a well-proportioned training, which shall include the development of all the qualities which make for a well-rounded personality, a liberal culture, and a useful knowledge of the conditions in industrial, commercial, or professional work today. With such an equipment, the Antioch student should fall more quickly into his stride than the young man who on leaving college must adjust himself as best he may, to the untrod ways of life in the outside world.

We are all familiar with the age-long controversy as to the respective values—the values expressed in efficiency—the “college-bred” and the “self-made” man. Antioch aims to send its graduates out into the world, equipped with the culture and mental training of the one and the practical knowledge of men and methods of the other. Obviously, to secure this dual training requires a longer college course than the usual four years, and the course at Antioch calls for six to seven years of study and work during each of six successive years.

An incidental but important advantage is the fact that the students become practically self-supporting, the usually haphazard process of “working one’s way through college” being changed into a systematic part of education. The more important, however, is the development, through self-imposed discipline, in real situations, of those qualities which are conspicuous in the “self-made” man, qualities such as courage, initiative, the sense of responsibility, and the ability to measure one’s powers.

And so it comes that the student has six yearly opportunities to determine, by actual experience, the calling for which he is best fitted.

It is scarcely possible to overstate the importance of that hour when a young college graduate, standing on the threshold of life, has to choose a career. In his mind the field is all untried, and, except for the case of specialized schools and colleges, or of those who take special courses, the choice is made on no more rational ground than that the child’s “fit” will be an engineer, lawyer or merchant. If the choice should happen to be suitable to his character and capabilities well and good. But if not, one of two things will happen: the young man of course and resources will “circulate around” until he finds the work that falls in with his training and capacities, or, if because of an inherent timidity, he is lacking in initiative, he will go to swell that great army of employees in whom a distaste for their work has stifled all active ambition.

The Antioch scheme aims to prevent the occurrence of such tragic failures by launching the graduate upon a carefully-chosen career, enriched with a liberal education, and equipped with several years of practical experience.

Progress in Railroad Electrification

THE APPLICATION of electric traction to the railroads of the United States is proceeding quite closely along a line which was pre-dictated fifteen or twenty years ago. At that time two ambitious schemes of railroad electrification had been floated upon after thorough investigation of the problem by expert committees, namely, the complete electric operation of the New Grand Central Station,

New York, and of a zone of thirty miles of the New York Central line between New York and Croton on the Hudson. The other project was the electrification of the New Haven line four track line between New York and New Haven.

The public was quick to realize the grand scale upon which this electrification of the steam railroads of the country was being commenced, and predictions were freely made that, within a decade or so, steam would give way entirely to electric and the steam locomotive would take its place in literary museums. As usual, the imagination of the public ran far ahead of the facts, and the electrical engineers of the day made haste to explain that, for many years to come, the electrification of the railroad system of the country would be confined to city terminals, to heavy suburban passenger traffic, and to the mountain divisions of the railroads where the grades were heavy and where water power was available.

The history for the past fifteen years has proved the truth of these predictions for electrification has been applied on a large scale only to city terminals and suburban service and to the heavy grades of western divisions. The latest development of this kind is the decision of the Virginia Railroad to electrify 131 miles of their system lying between Roanoke, Va., and Martinsburg, Va. This stretch includes a considerable distance where the line crosses the Allegheny Mountains, and it includes a heavy grade of about 2 per cent over which electric coal must be hauled on its way east to go and visit London and return to New York. A safe prophecy excepting it to be the first.

Another reference will be made to the electrification of the following “Lieutenant Mearns has published some charts of ‘Winds & Currents’ He has discovered a region of better sailing along the coast of North America, whereby the passage to Japan, China and all places south of the equator is shortened some ten to fifteen days.” Any navigator who went the track of his vessel with a record of his winds and currents to Washington was supplied with a set of these invaluable charts.

Strength of Metals Under High Temperature

THE GREAT advance which has taken place in working steam pressures with its consequent rise of temperature renders the question of the strength of metals at high temperatures one of increasing importance. Furthermore the gas turbine is now seeking admission into the field of rotary prime movers, and the necessarily high working temperatures of the gas will render still more acute the problem of providing metals which can be subjected to high temperatures without a prohibitive loss of strength.

We have before us a diagram showing the temperature effect on the tensile strength of certain metals, published in the April issue of the *Marine Engineer* and *Naval Architect*, and compiled from data published by the Directorate of Research of the Air Ministry, which throws valuable light upon this subject. Thus we learn that there is generally a rapid fall in strength with rise of temperature, which is so rapid in bronze and muntz metals, that the manganese bronze specimens, which had a tensile strength of 41 tons at 100 degrees, fell to 21 tons at 400 degrees and 6½ tons at 750 degrees, while the electro steel test piece fell from 25 tons at 100 degrees to 18½ tons at 800 degrees.

The best results were obtained with a five-per-cent dropped from a tensile strength of 49 tons at 100 degrees to 36½ tons at 210 degrees to 35½ at 380 degrees, and then rose to 40 tons at 570 degrees. Naturally the behavior of this alloy is variable according to the percentage of nickel employed. Above five per cent the efficiency at first deteriorates, but with as high as 85 per cent nickel a tensile strength of 40 tons at 100 degrees was obtained at a temperature between 800 and 1000 degrees Fahrenheit. The highest strength at the highest temperature was 38 tons at 1800

degrees Fahrenheit; this with a nickel chromium steel.

Excellent results were obtained in the Royal Air Force by the exhaust-gas turbine supercharger for supplying air under pressure to carburetors at high altitudes. Although the Tungsten steel rotors were only a few inches in diameter, they ran with a blade speed over 800 feet per second in a temperature of about 1200 degrees Fahrenheit. Coming now to the gas turbine, Holzwart, in describing his gas turbine tests, stated that he used electro steel with a yield point of 35 tons and a breaking strength of 57 tons at a temperature of between 800 and 1000 degrees Fahrenheit, the strength of his metal at 90 degrees Fahrenheit being respectively 25 and 26 tons per square inch.

We must beware of drawing hasty conclusions from the above results. Before they can be considered reliable, the time element must enter into the tests, for we are told that in the case of alloys there has been noted a tendency for the constituent elements to separate out under high temperature of continuous duration.

Seventy five Years Ago

SEVENTY FIVE YEARS AGO seems to have given us much attention to the sea and ships. Seventy five years ago as it is done today, but how does this strike you for a prediction. “Perhaps it would not be too much to predict that in fifty years we shall be able to sail from New York to the Atlantic, and for \$20 any citizen will be able to go and visit London and return to New York.” A safe prophecy excepting it to be the first.

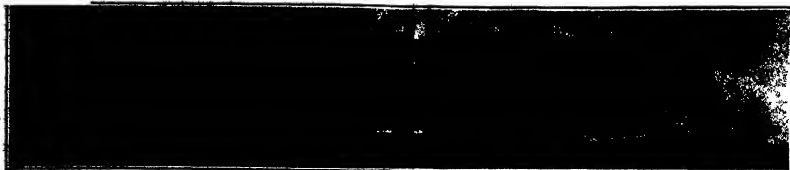
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The Coast Survey was doing good work seventy five years ago in the collection of specimens from samplings. Mention is made of the fact that Professor Agassiz accompanied Captain Davis on his hydrographic work for the Coast Survey, and that he had hoped a rich harvest of discovery, relative to the intimate which inhabit different depths of the water.

The Editor gives enthusiastic over the new “Croton Bridge” now in the course of erection over the Harlem River in this city. “This great work is the most extraordinary which we take into consideration that it is a conduit for water brought for a distance of forty miles to supply a city teeming with 400,000 inhabitants.” The city government of today understands better the value of art and history and sentiment for its contemplation throwing this noble bridge into the discard.

Some statements regarding the Pacific railroads are given from which we learn that the total length of all roads was 9233 miles. There was no act of Parliament requiring that express trains be run to the extent of one daily, carrying passengers at not over a penny a mile at a speedier rate than less than twelve miles. It was further required that carriages be provided with seats and protected from the weather.

A letter from H. W. Deane in our issue of June 17, 1868, refers to a copy of Russell’s early work on invention, etc., which he sold to the Patent Office, with the result that “a number of applications were made, were, very few of them, of their exhibition in his pages.” Commenting on this letter the editor writes: “This is another nail in the argument for the Smithsonian fund to publish a work of the kind.” No one would believe, unless he had read experience of the fact the great amount of time and money expended every year in inventing, something old.”



Mallet mountain freight locomotive for freight service of the Pennsylvania Railroad. Weight, engine and tender, 794,000 pounds. Tractive effort, 135,000 pounds

Three Notable Locomotives Which Mark the Trend of Moderning

WE present illustrations of three locomotives, one passenger, and two freight, which may be taken as representing up-to-date practice in locomotive design and construction. Each is designed to meet special requirements of certain parts of the line of the railroad systems for which they have been built, and in each the object has been to secure the maximum amount of hauling power, compatible with the limitations of weight upon track, bridges and other structures of the particular systems concerned.

Among the latest achievements in locomotive development is the Mountain Type locomotive for handling heavy passenger trains, recently designed at Omaha, Neb., by the Union Pacific System. This locomotive has the slightest weight per horsepower of any as yet built in this country, which is 96.57 pounds per indicated horsepower. The reduction of weight has been secured by careful design combined with the use of high-grade material, including carbon-vanadium steel for the main and side rods. An ample factor of safety is provided, with unnecessary deadweight eliminated. An order for 50 of these locomotives has recently been completed by the American Locomotive Company for the Union Pacific System.

An indicated horsepower of 3000 has been developed at 30 miles per hour, which is a higher rating than is obtained by the Cole formula. Practically a 10 per cent boiler is provided, and no difficulty is found in maintaining the required steam pressure. Firing facilities are provided by the application of a mechanical stoker, and a power reverse gear, operated by compressed air, is used. The tender of the cylinder type has a capacity of 12,000 gallons of water and 20 tons of coal, and is mounted on six wheel trucks. The Mallet superheater is employed. The principal data are given in the following table.

Length over couplers	80' 6 1/2"
Cylinders	25" dia. x 28" stroke
Diameter of drivers	78"
Weight on drivers	230,000 lbs.
Total weight of engine and tender	292,000 lbs.
Tractive power	84,888 lbs.
Total heating surface	16,827 sq. ft.

The majority of these engines will be used between Cheyenne, Wyoming, and Ogden, Utah, a distance of 464 miles, where heavy grades are encountered. Thus for the first 31 miles out of Cheyenne there is a steady grade with a total elevation of nearly 2000 feet, and about 10 miles of 1.50 per cent ruling grade. There is

also a considerable mileage of 1.14 per cent ruling grade eastbound out of Ogden. In designing a single, powerful locomotive to obviate the necessity for using double headers, it was decided to build it for fast running on level or down grade sections of the line, and capable of fairly high speed on long stretches of 0.82 per cent grades when hauling heavy trains. In service, one of these locomotives can haul 810 tons at a speed of 50 miles an hour on a grade of 0.82 per cent, the locomotive developing an indicated horsepower of 3000, which gives the rate of 96.57 pounds per cylinder horsepower as noted above. At a speed of 30 to 35 miles per hour,



Electric locomotive, mountain division, Pennsylvania Railroad. Weight, 148 tons. Tractive effort, 87,300 pounds

the careful counter-balancing was shown in the smooth riding qualities even at that high speed.

The imposing Mallet freight locomotive, which we illustrate, may be considered to be the most powerful in existence today. It is true that some locomotives such as the Virginian, are larger and heavier, have a greater starting power in getting a heavy train in movement, but in the opinion of the officials of the Pennsylvania Railroad Company who designed and built it, this engine will expensure more water and deliver more horsepower than any locomotive of which they have knowledge. We think that the claim is fairly established.

The locomotive is carried by eight pairs of driving wheels, and two wheel trucks under the front frame

The driving wheels are grouped in two sets of four pairs each, and they are 82 inches in diameter. The total load on these drivers is 340,000 pounds, and the total weight of the locomotive is 275,000 pounds. Adding the weight of the tender, we get a total weight of 794,000 pounds. The maximum tractive effort is 135,000 pounds. The boiler is of the Mallet type, and the barrel has an average diameter of 168 inches. The fire-box is 108 inches in length by 80 inches in width, and the total evaporating surface is 16,827 square feet.

The locomotive is driven by two sets of simple cylinders of 30 1/2 inches diameter and 28 inches stroke, thus departing from the usual practice in Mallet compound locomotive design, but a power roughly equivalent to that of compound locomotives is obtained by the use of a 90 per cent maximum cut-off, with a valve of unusually long stroke, giving a quick release. This half stroke cut-off has a decided advantage in point of steam consumption over a simple locomotive, having a cut-off varying from 10 to 25 per cent of the stroke, in which there is excessive cylinder condensation. The boiler pressure is 225 pounds per square inch. The front and rear engine frames are articulated for passing around curves by letting steel cuttings between them, forming a jaw opening connected by a chain pin. This device, operating in connection with powerful central springs, and thoroughly lubricated sliding surfaces, enables the entire front engine to move laterally so that its articulation with the rear engine when passing around curves of 400 feet radius. It should be stated that the locomotive is fired by a duplex stoker, and that the grades are operated by a Franklin steam grate shaker. The tender has a capacity of 14 tons of coal and 12,000 gallons of water.

We present also an illustration of an electric locomotive, designed and built at the Altoona shops of the Pennsylvania Railroad. This locomotive was built for test purposes, in connection with the decision of the company to electrify that portion of its mountain line traversing the summit of the Allegheny Mountains. The locomotive is now being experimentally tested on that part of the line which has already been electrified between Philadelphia and Pottsville. The principal characteristics of this locomotive are as follows:

Overall length	70' 6 1/2"
Total wheelbase	67' 1 1/2"
Diameter of driving wheels	72"
Diameter of pony wheels	30"
Weight on drivers	196 tons
Number of driving axles	8
Total weight of locomotive	240 tons
Tractive effort	87,300 pounds



Heavy passenger locomotive for mountain grades of Union Pacific Railroad. Weight, engine and tender, 535,000 pounds. Tractive effort, 54,838 pounds



Counterweighted lift lock for a lift of 126 feet, as proposed for the Rheine Danube Canal, showing the platform of the lift which has to be craned for a distance of fourteen miles at an elevation of 1556 feet

When the Canal Barge Takes the Elevator
The lift lock is one in which a huge tank capable of receiving the vessel to be raised takes the place of the usual stationary lock of masonry. The type is especially useful in localities where as in the German lock here at a steep bluff or cliff calls for a single lift of great height.

In this design the tank and its contents are counterweighted making necessary a massive supporting structure. Both ends of the tank and of the canal reaches are closed by double-walled gates which provide security in case of damage to either inner or outer walls. The gates are raised by electrically operated winches which are so interlocked with the main winding gear that the trough cannot be moved while the gates are open and neither the trough nor the reaches can be moved unless the trough is in an end position and properly aligned with them.

The weight of the trough and contents is balanced by a series of counterweights arranged in groups and suspended by wire ropes. As these weights are independent of each other each rope is to carry only the assigned load. A frame surrounding each group of weights transmits the full weight. If the rope should part the load of the counterweight would be distributed evenly among the remaining ropes. A single locking requires about 17 minutes and does not require about the same interval. Owing to the counterweights power is required only to overcome starting friction and friction.

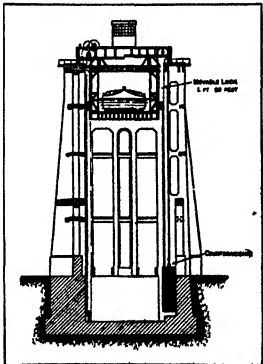
We are indebted to Duisburg and three associated German firms to the joint designers of the lock for the illustrations which emphasize the fact that a distinctive feature of the design is the handling of heavy loads by subdividing, first, and distributing them over a large number of comparatively small carrying elements. In this way details are kept within limits that have already been proved adequate and safe in actual practice and any further element may be replaced quickly without disturbing the operation of the entire installation which has been made the subject of our present illustration.

Tests of Welded Tanks

The investigation of the strength of about 50 tanks of a type which had been welded by gas and some by electricity has been completed. This work which was carried out in cooperation with the American Bureau of Welding was begun on December 4 and completed in February 9 and gives reliable information on the strength of welded tanks for the consideration of the Pressure Vessel Committee of the Boiler Code Committee of the American Society of Mechanical Engineers.

The results showed that double-V longitudinal welded seams are much stronger and more reliable than single-V welds. Recommendations were also made covering the design and construction of the heads. The occurrences at which these tanks failed were so high that confidence in the safety of welded tanks, which are properly constructed has been greatly increased. The

method of testing by hammering the weld while the tank is under a pressure of one and one-half times the working pressure, was discussed. Although this test did not prove as effective in showing up defective welds as had been hoped its use is nevertheless justified. Another acceptance test proposed in this report is to increase the pressure until the shell of the tank reaches the yield point. These tests show that the tanks are



Front elevation of the counterweighted lift lock, showing the operating principle

safe after being tested in this way. As it is probable that tanks having large outlets would be seriously depressed and therefore rendered unserviceable, this test is not likely to be adopted, but an increase in the test pressure will probably result.

It is especially commendable to note that the Bureau of Welding which represents one of the strongest of the engineering industries, has a large number of important problems which it expects to solve. Their importance will be realized when it is considered that they affect almost every one because of the waste of material which results when designs are based on insufficient data or are influenced by prejudice, according to the Information Section of the Bureau of Standards.

Sir James Dewar

SIR JAMES DEWAR, whose death was recently announced, is popularly known to the world as the inventor of the thermos bottle. However, he was not consciously working for what is thus known but rather for something to preserve liquid gases, with which he was experimenting. The use that his Dewar tube is now nearly put to came as an afterthought, not so much of his own but of the commercial world. It is true however that Dewar used his invention himself for such purposes, but had no intention of commercializing it. He was later able to liquefy hydrogen and he froze it at minus 438 degrees Fahrenheit. He also isolated hydrogen helium and neon from the air. He was also the joint inventor of coctail. He died at the age of 61 years.

Spontaneous Changes in Balance

The Bureau of Standards has just completed a careful comparison of the results of successive tests carried out on two of its highest grade analytical balances. These balances have been used constantly but with extreme care for some years. Both balances showed appreciable changes in the ratio of the areas of the beam which could not be explained as the result of wear of the knife edges. The Bureau concludes that these alterations are the effect of spontaneous changes in the beam probably caused by the gradual release of stresses set up during the manufacture of the balance. This study corroborates evidence of such changes noted in many balances of this type and supports the long-established policy of recommending that analytical and similar balances be checked occasionally by the users.

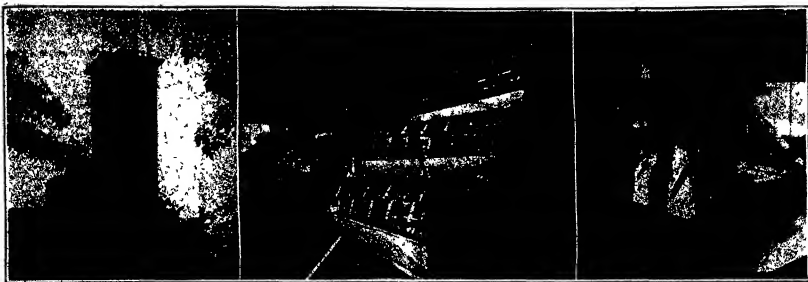
Spectrophotoelectrical Sensitivity of Argentine
CIEBUTIPPO Paper No. 446 of the Bureau of Standards deals with the above subject. It may be obtained from the Superintendent of Documents, Government Printing Office, Washington D. C., at 5 cents a copy.

Substances which decrease in electrical resistance when exposed to light are said to be photoelectrically sensitive. Selenium is the most commonly known substance having this property.

The interesting nature of this phenomenon is not unduly obscured by the fact that it is thought that this change in resistance may be caused by a change in the form of the crystal when exposed to light.

Silver sulfide presents the prospect of crystallizing in two different formations, according to which the three photoelectric rates are all equal and variable, in which the area of the surface is constant, and, finally, in which the area of the surface is variable.

The results described in this paper will be of value in showing that the form of the crystal affects the photoelectric change, but it is not the underlying cause of photoelectric sensitivity. The results are of value in showing that the area of the surface is not the cause of the change in resistance. See also the paper on silver sulfide in Scientific Paper No. 446.



Left: The shot tower. The molten lead alloy is dropped from a sieve at the top and falls into two tiers. After molding, it is directed to the wire of the building and follows by gravity from tier to tier. It is given a preliminary polish and then passes over a series of dropping plates having small gaps which the truly round shot are able to jump; while the imperfect ones must wait up enough speed to jump the opening. Center: Another view of the shot tower. The revolving screens are continually traversed by rollers which keep the shot from remaining lodged in the screens. Right: After the shot has been smoothed they are given a final polish and heaped for shipment.

From beginning to end of the process of making shot there is no need for the workmen to touch the shot. Each of the several processes is done by machine and gravity carries the shot from stage to stage.

Mathematically Perfect Balls of Lead Called Shot

IF the end of an ordinary shotgun shell be uncrimped, it will roll scores of shining shot, beautifully finished, perfectly graded as to size and absolutely round. Without these prerequisites the hunter will have just cause to complain of the chance of shot in the shells he uses. If the individual pellets are out of round, or if they vary in size, he will return from the hunt with less game in his shooting jacket, regardless of how good a shot he is, than he otherwise would. And a charge of shot, fired under test conditions at a prepared target will show up the cause of the disappointment. The pattern will be less perfect, many of the bullets having fallen short because their imperfection results in a lower velocity through the air than the average of the charge, while others are diverted from the theoretical course because they are not round.

To produce, day after day, year in and year out, shot that are truly alike, true to size, round, equally balanced and equally hard because of identical composition and identical methods of production has required the perfection of a process, which, far from being merely the dropping of a lot of molten lead from a sieve into cold water, is highly specialized from start to finish, involving the previous manufacture for the purpose of a whole family of special machines and the training of a special force of mechanics in traditions of care and accuracy. The descent of drops of molten lead from a high tower into water, although an ancient method of making shot, is still retained, but only as the heart of a lengthy but modern scientific process. With it is retained the ancient shot tower, and it is one of these structures, a landmark on the skyline of New Haven, Conn., which contains all the special machinery that turns lead and antimony, in varying proportions according to the degree of hardness desired, into 50 tons of shining pellets every working day.

From the time the molten lead pours from the big ladles in the top of the tower until the shot is delivered over the counter in the shell it is not touched by human hands. The whole chain of processes is automatic. Gravity moves the product from machine to machine, and the machine does all of the work.

As shown in the cross-sectional diagram of the shot of the tower, there are at its top two melting pots and two drop tubes. The significance of this is simply that two kinds of shot are provided for the distilled and the cast, or drop shot. These varieties are made by using different percentages of antimony with the lead. Otherwise the two are made in exactly the same manner. Therefore in our description we shall omit the lower melting pot and follow the structure of

drop shot from the upper of the two ladles. The lead is mixed with the antimony in the desired proportions in the furnace at the ground level. This is shown at the left of the diagram.

From here, after being run off in pigs, it is elevated to the melting pot at the top of the tower. The temperature of the molten mass is always kept uniform a precaution very necessary for the production of truly round drops of falling metal. The cauldron must also be stirred constantly in order to keep the molten fluid at uniform viscosity throughout.

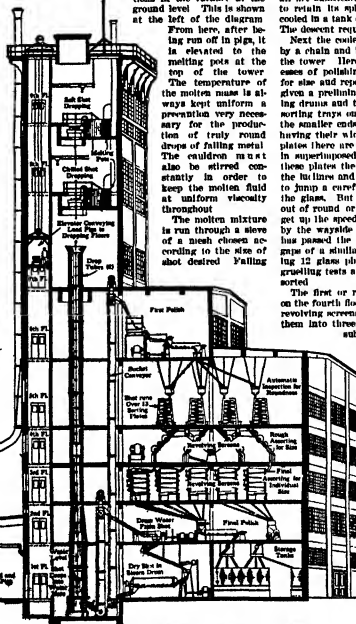
The molten mixture is run through a sieve of a mesh chosen according to the size of shot desired. Falling

thence through a distance of 154 feet, the drops assume a perfectly round shape, and as they fall through the air are sufficiently cooled to form a crust strong enough to retain its spherical shape until the shot has been cooled in a tank of water at the bottom of the structure. The descent requires but 3.1 seconds.

Next the cooled shot are dried by heat and returned by a chain and bucket elevator half way to the top of the tower. Here are begun the several finishing processes of polishing, inspecting for roundness, assorting for size and repolishing. At the sixth floor the shot is given a preliminary graphite polish by two large rotating drums and then it descends by gravity to the glass sorting trays on the fifth floor. Here it is carried to the smaller ends of a series of glass, fan-shaped plates having their wider ends inclined downward. Of these plates there are 15 in each tier and they are arranged in superimposed zigzag form. As the shot roll along these plates the perfectly round ones run freely down the incline and the speed thereby gained enables them to jump a carefully adjusted gap at the lower edge of the glass. But any individual shot which is slightly out of round or which is imperfect in any way cannot get up the speed necessary to make the jump and falls by the wayside later to be remelted. The shot which has passed the first gap must, however, pass 12 more gaps of a similar nature, corresponding to the remaining 12 glass plates. At the end of this series of 13 grading tests all the shot is considered to be perfectly sorted.

The first or rough sorting for size now takes place on the fourth floor. Here the pellets are passed through revolving screens which are perforated in order to sort them into three general sizes, the more particular or subdivided sorting of the products occupies the first screens taking place on the floor below. The shot is now given a final polish which adds the perfect luster, which characterizes good shot, and it is thence conducted to the storage tanks.

Tests for diameter number of pellets per ounce, hardness, roundness and general appearance are now made on the finished product. Cooled shot being harder than drop shot, is not mutilated as much when fired from the bore of a shotgun, and therefore gives better patterns. The makers, knowing that shot soft has better killing powers than chilled shot due to the upsetting of the shot in the game, have found it necessary to have a standard hardness for each individual size of shot. The poured shot runs in from dust to size "T", making a total of 20 sizes. But the nine sizes of bush shot are cast. There are also ten sizes of lead balls which are cast ranging from the .44 caliber to the 10 gauge ball.



A schematic plan of the shot tower and machinery for perfecting the shot

of Illinois. Heavy crops, heavy carry-over and money scarcity following the war have depressed the prices of agricultural products which are the first to reflect such internal conditions.

Through organized action governing the storage and marketing of crops, it can be expected to open a longer period in the future, and thus excessive fluctuations in prices as a consequence of rapid marketing at harvest time can be avoided. Future organization of a sound, wide and far-reaching character is the key to a more prosperous and better paid agriculture. Advancement in farm organization must go hand in hand with the improvement in the distributive machinery of the country. Potentially, American farmers must adjust their production to accord with national and world demands. If the world requires less pork and beef, the farm grower will have to modify his farming methods with such conditions. Our increasing population will probably demand much more beef and pork and this will mean that we must increase our own production. The extent to which meat will constitute a part of the diet of this larger world will have an important bearing upon future corn production.

The Fourth Dimension

There is a strange delusion that the third dimension must be something wholly beyond the conception of the ordinary man, and that only the mathematician can be initiated into its mysteries. It is true that the mathematician has the advantage of understanding the technical machinery for solving the problems which may arise in studying the world of four dimensions, but as regards the conception of the four dimensions of the world his point of view is the same as that of anybody else. As it is supposed that by intuition thought the mathematician throws himself into some state of trance in which he perceives some hitherto unsuspected direction stretching away at right angles to length, breadth and thickness? But that is an error.

The world of four dimensions is perfectly familiar to everybody.

It is obvious to everyone—even to the mathematician—that the world of solid and permanent objects has three dimensions and no more, that objects are arranged in a threshold order, which for any particular individual may be analyzed into right-and-left, backward-and-forward, up-and-down. But it is no less obvious to everyone that the world of events is of four dimensions; that events are arranged in a threshold order, which in the experience of any particular individual will be analyzed into right-and-left, backward-and-forward, up-and-down, sooner-and-later.

This means that the events around us form a world of four dimensions in as real as the facts that Queen Anne is dead. The reason why the relative recovers the ancient truism is because it is only in this undistorted combination of four dimensions that the experiences of all observers meet. In our own experience one dimension is sharply separated from the other three and is distinguished as the perspective of time and space, and if we insist on building the scheme of nature on purely terrestrial experience we are limiting ourselves to the medieval geometric system of the world.

We must try another plan. We can never eliminate altogether the human element in our conception of nature; but we can eliminate a particular human element. If our thought must be anthropocentric, it need not be geocentric. We must leave the perspective frame entirely indeterminate. When we do this, we find that the world common to all observers—in which each observer traces a different space-time frame according to his own outlook—is a world of four dimensions.

When we look at any object, say a chair, the impression we receive is a two-dimensional picture depending on the position from which we are looking, but we have no difficulty in conceiving of the chair as a solid object, not to be identified with any one of our two-dimensional pictures of it, but giving rise to them all as the position of the observer is varied. We must now realize that this solid chair in three dimensions is itself only an appearance, which changes according to the motion of the observer, and that there is a super-object in four dimensions, not to be identified with the three-dimensional chair in Ptolemy's scheme, or the same chair in Copernicus's scheme, but giving rise to both these appearances. —Abstract from *Romantic Lectures*, 1928, by Professor A. A. Haldan.

A New Vitamin Bread

THE discovery of a newly-perfected bread is the result of extended investigations conducted by the Mellon Institute of Industrial Research of the University of Pittsburgh in direct cooperation with the baking



Our corn loaf produces 48 per cent of the corn crop, 44 per cent of our pork, and 56 per cent of our beef.

experts and scientific staff of a leading baking company and a group of retained specialists in food chemistry. According to Edward H. Mellor of the Mellon Institute, there has been developed and put into successful commercial practice a method for the extraction of vitamins and minerals from the germ of the wheat berry. These products are used for enriching white bread in order to impart complete nutritive value and dietary balance. Dr. Wollfeber says that the food value of bread was formerly ascertained by chemical analysis, but that analysts failed to tell the entire story, the only accurate determina-

tion of the heat obtained by feeding experiments on human beings or animals.

It was proved that the heat obtained by feeding experiments on human beings or animals, if used as an exclusive diet, will not support life indefinitely. It was lacking in vitamins and mineral salts. When these were added, great improvement was noted. This is one of the most important economic factors on the earth. It is a factor that, as much as any other, perhaps, determines the degree to which a part of the world is or is not really favorable for a high and active and prosperous civilization. —Abstract from *Progress*, E. J. Henderson, *Scientific Monthly* for November, 1928.



Corn is produced on a very large scale for analysis purposes

lance the mineral salt constituents by the addition of the new wheat germ extract. The new bread resulted, and it is claimed that this perfected product, with only the addition of water to the diet, will sustain life indefinitely.

The significant part of the discovery lies in the recognition that some of our milling processes have been depriving our bread of their vitamins and mineral salts. The experience thus gained by the tests is a recapitulation of that gained by the soil expert. Until recent years it was believed that a chemical analysis of soil samples truly indicated the quantities of that soil, as well as the particular elements to be added to it in the form of artificial fertilizers. Today it is known that while such an analysis is of value in soil treatment, it is not the last word. It was often found that the addition of the elements indicated as lacking by the analysis did not produce the desired results. It is now recognized that the best way to determine what a soil needs is to experiment with the life that grows from it. If one wishes to know, for instance, whether a certain kind of soil will raise potatoes well, it is necessary to try growing potatoes on it that is, to "ask the soil."

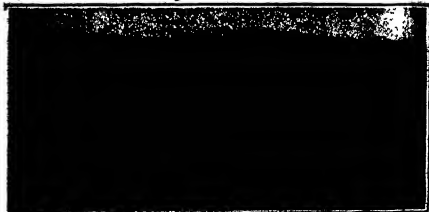
Analogously, in finding a bread that is a complete food it is necessary to "ask the body" by trying it as a complete food. Such tests, supplemented by chemical analysis in order to check up on the exact nature of the modifications made from time to time, finally brought out the desired loaf.

Water and the Climate

EVERYBODY knows how much more steady is the state of the weather on small islands at great distances from continents than in most other places. Everyone knows how much milder the climate is, how much cooler in summer and warmer in winter, the sea-shore than a comparatively small number of miles inland. This phenomenon is well known.

How does it depend upon water? What is the effect that water exerts in that respect? There are several factors. In the first place, water has a great deal to do to raise the temperature of water, or, as the physicist says, the specific heat of water is high. If you take, for instance, a pound of water and a pound of almost anything else—there are a few substances that are harder to heat than water—and heat them over a carefully regulated flame for a certain length of time, and measure the rise in temperature, you will find that the rise in temperature of the water is less than that of the other substance. There are a few exceptions, but there are very few. The result is that an ocean or a lake absorbs heat, and does not itself rise very much in temperature.

Again, the evaporation of water takes up heat. Everyone knows that. Everyone knows that in order to evaporate water away at all rapidly you must heat it, and the amount of heat that is taken up in this evaporation of water is greater than in the evaporation of anything else, that is to say, you have got to put more heat into water in order to boil away or to evaporate, let us say, a pound of it than you have in order to evaporate a pound of anything else. Thus the more rapid the evaporation the more effective the resistance of water to the rise of temperature, and for that reason the cooler the climate in the marine region compared with the climate in a region where there is no water to evaporate. This is one of the most important economic factors on the earth. It is a factor that, as much as any other, perhaps, determines the degree to which a part of the world is or is not really favorable for a high and active and prosperous civilization. —Abstract from *Progress*, E. J. Henderson, *Scientific Monthly* for November, 1928.



These corn crop very healthy in worth about as much as our wheat and corn combined.



Left: The recording instrument placed in a member of a bridge truss, with its fixed and movable page points in contact with the lower member. Right: Section of the recording mechanism, showing the mirror for the photographic recording film, the electric light for throwing the reflecting beam, and the little mirror at *N* which reflects the beam to the film.

The apparatus for detecting the stress actually produced in any member of a bridge with live load

When a Bridge Tells Its Troubles

A New and Ingenious Device for Measuring the Effect of Traffic on Bridges

A NEW device has been perfected by the U. S. Bureau of Public Roads which will determine the stress produced in any member of a bridge when a vehicle or train passes over it, no matter how great the speed. Engineers have long known how to design a bridge so that it may safely carry its own weight plus the load standing on it, but when it came to making a correct allowance for the impact which every moving load produces, they have had to estimate. The new apparatus is designed to furnish data long sought by engineers, so that in the future they will be able to prepare designs based on accurate information rather than on the mere attempt to make a liberal allowance.

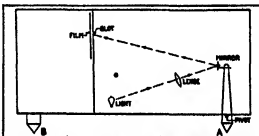
The device used, as described by E. B. Smith of the Division of Tests, makes a photographic record, by means of a beam of light, of the lengthening or shortening of any part of the bridge. From the data thus gained, when the size of a member is known, the stress in it can be calculated, and by other calculations that part of the stress which is produced by impact can be determined. Much information can be used in the design of new bridges.

The design of the measuring instrument is based on an optical principle, its essential features being shown in the diagram. *A* and *B* are the two page points. *A* being movable and pivoted as shown. At its upper end is attached, by means of an adjustable fixture, a mirror. By means of a small lens a beam of light is focused on this mirror and is reflected back to a photographic film.

In operation, any slight movement of the point *A* will rock the small mirror about its pivot, thus deflecting the beam of light and very greatly magnifying the original movement. By thus fixing a beam of light to magnify the movements of the bridge member it is made possible to eliminate all but two moving parts, namely, the page point with its extension and the mirror on its pivot. Since the movement in either case is extremely small, these parts respond readily with very little component effect of inertia. The greater part of the magnification is obtained by the movement of the reflected beam of light, caused in turn by the movement of the mirror, and as the former takes place without any effect of inertia whatever there can be no lag or overtravel of the recording beam. In order to make the instrument recording, a photographic film is so placed as to receive the beam of light which passes through a slot and makes a direct record of the variations in the bridge member on the film.

As shown in the photograph, the instrument, *L*, is a small electric light whose filament is focused through the lens on the small mirror at *N*. The image of this filament is reflected back across the vertical slot located in the partition of the instrument at *T*. Just this slot a roll of film is caused to move and receive the record. This motion is imparted to the film through a train of worm gears, driven by a small electric motor that is run by a storage battery. This battery also supplies current to light the filament.

With this instrument it is possible to get magnifications of more than 500 times the amount of the original deflection, but for most cases 200 times has been found



Movement of the page point *A* with regard to the lower page point *B* caused by the stretching of the bridge truss member is greatly magnified at the upper end of the film where the mirror and forms the moving page point *A*. The beam of light is focused by the lens on the mirror, whence it is thrown on the moving film, having a graphic record.

Diagram showing principle of the recording apparatus



At 4 miles per hour. The effect is very slight and uniform.



At 4 miles per hour there is an increased coefficient of the bridge, but the curves have greater amplitude. The entire curve lies above the line of sight.



At 10 miles per hour the amplitude of the deflection is much more pronounced, and the bridge is in a more critical condition in the truss as well as in the span, also motion of the beam is visible.

Graphic records made on the lower chord of a six-panel Pratt truss bridge by the passage of a 2-ton truck.

ample. The amount of magnification is calculated by placing the device on a specially constructed block and by means of a micrometer screw, moving the page point to a known extent and then measuring the record produced on the film.

Intensity and Duration of Fire

COMB experimental work has been undertaken by the Bureau of Standards in connection with investigations of the fire-resistive properties of building materials, to determine the actual fire exposures to which building constructions may be subjected as used to house various occupancies. In furnace fire tests of such constructions, they are subjected to fire exposure the intensity of which is determined according to a standard time-temperature relation, which has been thought to represent a moderately severe building fire, the duration of which will depend on the building construction and building contents, the latter being determined in a general way by the occupancy. Fires of long duration and high intensity are produced by such occupancies as heavy manufacturing, merchandising, and storage, with office and residence occupancies at the other end of the scale, as giving the lowest duration and intensity.

In the latest test which the Bureau has carried out a small building was constructed and furnished in such a way as to simulate an office occupancy. It was then burned out in a manner calculated to approximate an exposure fire. While interesting surveys of the contents of a safe were obtained, it is apparent that to be conclusive further experiments will be necessary, particularly to determine the effects of larger room dimensions on intensity and duration. Efforts are also being made to obtain an estimate of intensities of fire in buildings by examination of fire ruins. An inspection made of the Postington Building (Chicago, Ill.) after the fire of March 15, 1922, indicated that maximum temperature between 920 degrees and 1000 degrees Centigrade (1745 to 1822 degrees Fahrenheit) obtained generally over the burnt portion to judge by fixed metal, the melting points of which were later ascertained. At a few locations the temperature apparently exceeded these averages by about 100 degrees Centigrade.

Correction of Engine Crank Shafts

IN connection with the work on retuning indicating oils, something has been done in cooperation with others interested in two subjects of engine crank shafts. It has been thought for some time that the most serious part of crank-shaft distortion was the twisting correction, which appeared if the shaft was not very stout, the latter being that which is due to the crank set or to the barrel used in turning the shaft. It is possible that the twisting in all crankshafts was due to the use of the barrel set. A machine exists at which, by means of a set of worm gears, driven by a small electric motor that is run by a storage battery, this battery also supplies current to light the filament.

A New Gasoline-Electric Freight Train

THE "mini" freight train designed by the Austro-Daimler Motor Company, of Vienna, is made up of two vehicles: first, the engine car or tractor, carrying the gasoline-electric set for generating the electric energy required for propulsion and for controlling the train service; second, a trailer, designed to receive the useful load.

The tractor, which itself carries no useful load, is a double-axle vehicle fitted with a 100-horsepower water-cooled six-cylinder gasoline engine, rigidly coupled to a shaft-driven constant-speed dynamo, as well as with all accessories such as electric lights, starter, auxiliary carburetor, etc., and a captain installed at the rear end of the tractor. In addition to a self-acting vacuum brake, the vehicle carries a hand-operated brake. The rear wheels are driven from two electro-motors, each of about 15 horsepower. The tractor is designed for traveling both on the road and on rail—on standard-gauge tracks as well as on the wider Russian tracks. The trailer carries its considerable useful load of 25 to 30 tons distributed over four axles in order to insure an axle pressure as low as possible. All eight wheels are driven by electro-motors, thus warranting the tractive force required. The trailer mounts both a self-acting vacuum brake and hand brake, thus insuring safe braking of considerable loads on gradients. The four-axle trailer is made up of two pairs of single-axle bogies connected together by horizontal links and constructing the front and rear cars respectively, which, in turn, are joined by a girder. The weight of the tractor is about eight tons, that of the trailer about 19½ tons. The maximum traveling speed of the train on level hard roads of medium quality is about 10 kilometers per hour and its maximum climbing capacity is a grade of 25 per cent. All these data are relative to full-load operation.

Another Cotton Picker

AMONG the inventions of the few years have been several cotton pickers of unusual promise. That it has always been necessary to pick cotton by hand is well known, as are the enormous economies and the expanded production that would result from a completely successful machine picker. We have illustrated one or two recent attacks upon the problem, and now we show another.

This machine is designed primarily to be run from a cheap gasoline engine, while electric drive is quite practicable so far as the machine is concerned, it is not very convenient for use in the cotton fields. The picker alone weighs 700 pounds, and can actually be pulled by horse or by hand, if necessary. It is small enough to pass between the rows, and by means of a wide extension bar which carries the suction tines far to the side of the machine, it can be made to pick

eight or ten rows in a single trip across the field. The suction not only picks the cotton, but gathers it in a bag toward the tractor. The cotton is gathered through a hose, twenty-five feet long, and all that the operators—two to each horse—have to do is to carry the nozzle to the plants and about them to the individual bolls. As fast as the operator can touch the nozzle to the cotton it flows out, passing the bag in the tank. It is claimed that four operators on the nozzle and a fifth on the air supply can gather at least 5000 pounds of cotton a day.

A powerful suction rotary pump is used, handling a large volume of air at low vacuum. Two tanks are employed, so that air can be shuttled from the full one to the empty one in connection with the emptying of the tank of cotton, making it unnecessary for the picker to stop his work. It is emphasized that the cotton is picked absolutely clean—that it "picks out and begins to go" before the nozzle even touches it, and that there is no necessity for taking any leaves or parts of the pod. The entire handling of the cotton after it is removed from the boll is taken care of, automatically, by the machine, which differs materially from others already described.



Improved type of traction belt for automotive use, and (insert) a detail of the shoes and their connections

the first row since the second will be clear from it. The belt consists of a certain number of links and stretching across by means of which the assembly can be drawn tight about the wheel. During the rotation of the wheel, the tire revolves upon the inner surface of the shoes, which are successively lifted upon the ground. When the shoe has been replaced by the preceding one, its turntable reaches the upper end of their course raise the shoe, and turn it about so that it is ready to be planted in the ground again. At every revolution of the wheel, the shoe will first drop down on its own weight against the tire, and later will be lifted forward, these two sudden displacements in opposite directions will shake the shoe and usually free it from clinging dirt.

It is the system of suspension involved that is claimed to constitute a simplification of the caterpillar system. Instead of the shape and proportions of the suspension are such that the kinematic couple comprising transmits and

suspension holes serves not only for placing the shoes in front of the wheel and raising them, but also for doing so at the same time for the power engagement of the wheel with the shoes. The weight of the vehicle bears directly on the rim of the wheel, upon which the wheel will revolve without any sliding action, and the whole traction strain is supported by solid couplings and by a chain. We are obliged to omit various other substantial details which have contributed to the practical success of the system. The advantages claimed for the system include the following:

It is applicable in all kinds of wheels, whether driving wheels or condensed driving and steering wheels. Give the simplicity, ease and rapidity with which the device can be put on and removed, all motor vehicles will be able to use their highest speeds on ordinary roads, and at the same time it will have at their disposal an apparatus which insures perfect adhesion and allows them to travel and work, away from made roads, upon the worst and most irregular ground. The motive power is used to the maximum degree partly owing to the perfect adhesion of the driving wheels, and partly because the edges of the suspension holes are limited, whatever the ground may be like, to the gliding of the transmits against the edges of the suspension holes. The use of the device reduces the wear of the rubber tires to a minimum, as they roll easily and without slipping, upon the metallic surface of the shoes.

To Disinfect East India Hides

AMERICAN interest in the British Indian hides and skins, reports Vice Consul Elzette at Madras, has increased to learn that the installation of a hide and skin disinfecting plant in Madras is being planned by a native concern. The proposed plant will be equipped to handle about 2000 skins per day. The enterprise when in operation will be of considerable simplicity and facilitate the direct shipment of raw stock from southern India to the United States.



Separate views of the tractor and trailer of the new Austrian gasoline-electric road train

The Centipede Wheel

POWER without traction is proved useless every time a four wheel auto or trailer is stuck in a ditch. In one form or another obviously gets the most nearly infallible traction that one can hope for. But the centipede wheel has disadvantages which have heretofore limited it to agricultural work in heavy ground, where its advantages outweigh the drawbacks. An Italian artillery captain, M. Guerrieri, has perfected the apparatus illustrated herewith, designed to bring centipede efficiency to road vehicles, divorced from caterpillar cumbersome, slowness and multiplicity of parts.

The Guerrieri device, in a simple and practical manner, provides any driving wheel with an anti-slip traction apparatus which has a large bearing surface and is light and easily removable. It is in fact a veritable caterpillar in which the rollers, gear wheels and like parts are suppressed, and their functions performed by shoes attached to the driving wheels of the vehicle. In the case of road tractors and subcompact vehicles these shoes are applied by means of a self which can be quickly adjusted and stretched over the tire, and in other cases, such as agricultural tractors, without help by means of independent shoes mounted around the wheel in the way chains are sometimes mounted. We may combine ourselves to



Five thousand pounds of cotton in a day by five men in the chain made for this suction picker

Elevation and Range of British Naval Guns

Main Armament of Capital Ships Remains Today as Originally Designed and Constructed

By Hector C. Bywater

THE MILITARY value of high elevation in turret guns of battleships is a subject on which considerable discussion has taken place in the United States during recent months. Public interest was first attracted to this question by positive statements, appearing in the *London Times* from the Navy Department, that British battleships of the post-Treaty fleet had, on the average, a higher angle of gun elevation than American ships, in consequence of which the former were able to outrange the latter by several thousand yards. This superiority of range on the part of British ships was due, it was alleged, to alterations made since the war, or at any rate at some time subsequent to their original entry into service. On the strength of these reports Congress was requested to appropriate funds for modernizing the United States battle fleet, and particularly its turret gun mountings, with a view to enabling the United States to use its artillery at maximum ranges, thus nullifying the advantage which the British fleet was supposed to have in this respect. After the money had been duly appropriated, the British Government announced, through the usual diplomatic channels, that no alterations of the character indicated had ever been made in the turret mounts of any ship of the Royal Navy since its completion. This categorical denial was at once accepted by the United States naval authorities, the "various types of Active Secretary Bonswell's reticence being much more than counterbalanced, however, a conviction still prevails at the Navy Department that the showing range of the British fleet is higher than that of the United States, and accordingly it has been proposed to carry out the plan of enlarging the gun elevation of 13 ships, viz., "Florida," "U.S.A.," "Arkansas," "Wyoming," "Pennsylvania," "Arizona," "Oklahoma," "Nebraska," "New York," "Texas," "Illinois," "Idaho," and "New Mexico."

It may therefore not be inappropriate to outline some of the technical aspects of this question as seen from the viewpoint of a British naval student. It would be desirable to give all units battery guns the extreme limit of elevation practicable, 4, e. the 42 deg or 43 deg equivalent to maximum elevation. In the case of these, if this could be obtained without corresponding disadvantages, but it cannot. Compromise is necessary, and the following remarks convey an idea of the factors governing this compromise. To place first at sea level. In the post-war naval war with France, Holland and Spain, the truck guns carried by the British fleet were given a maximum elevation of 10 deg to 15 deg, and a search through the available records of a complaint that this limit was insufficient. A larger elevation would have involved a deeper gun port, or else the gun would have struck the top sill on recoil. A lower elevation was unacceptable for an other reason. In the course of the famous English maneuver, the attack from windward, their ships were all listed by the wind toward the enemy, and the circumstances greatly favored the speed with which a broadside could be fired, since the heaving over of the ship provided a natural "ramp" or incline which checked the recoil of the guns and accelerated their running-out after loading. This enemy ships, on the contrary, suffered from the corresponding disadvantages. And in the case of the French fleet, a further cause of inferiority resulted from their tactical policy, for whereas the British fleet was content to dig in the enemy's hull, the French generally fired high in the hope of dismasting their opponent. Both sides therefore required a high elevation of their guns, but the French more than the English.

When, about the middle of the nineteenth century, the power of ordnance became too high to be controlled by truck carriages, slide mountings were introduced; the gun deck recoiled, according to a fixed sloping path and thereby expended the energy of its recoil. But great difficulties were experienced in controlling this recoil. If fired at too low an elevation the gun ran up too violently, while if fired at a high angle the downward blow on the slide was excessive. The steeper the angle, and the higher the maximum elevation of the gun, the more dangerous the blow became and the less distance the gun recoiled. Eventually it was found necessary to limit the incline of the slide to 15 deg, and the elevation of the gun to 15 deg. also. The above system was superseded, as the power of ordnance

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IN OUR April issue we exposed the fallacy of the propaganda which stated that the names were not scrapping the ships required to be destroyed by the Washington Naval Treaty. We showed that Great Britain alone had scrapped the explosives and ordnance condemned under the Treaty and also in the four years since the Armistice had destroyed, voluntarily, a fleet of some 640 battleships, cruisers, destroyers and other vessels. And now, from the same source, we are told that that perfidious Alban has been surreptitiously elevating the guns of the battleships allowed her by the Treaty, with the result that the United States fleet is today hopelessly outgunned. Mr. Bywater's article shows that nothing of the kind has been done by the Germans as they were built. In an engagement, the superiority of range would at the outset be with us, because of the 34,000-yard range of two of our 14-inch gun batteries. Then the advantage would pass to her, since, with superior speed, she could lead a controlling range of 23,000 yards. This ENTIRE.

further developed, by the great Swedish invention of the hydraulic recoil buffer, which allowed the gun to recoil axially whatever its elevation. This system permitted of high elevations, which some naval officers have regarded as the death-knell of the battleship. When the British fleet first met the German fleet during the Spanish crisis of 1878 there was not a single gun which could bear on the Turkish batteries, and it was fortunate for the fleet that no hostile demonstration took place. Some years later the British fleet designed turrets whose guns had 40 deg elevation, and several of these were supplied to the Italian Navy. But official naval opinion was in all countries op-

pose the effect of these gun port gaps is one of the problems of turret design. In United States ships the turrets are usually placed close to the front sloping armor plate. With the exception of Germany, no nation before the war was any particular heed to this feature of maximum elevation, and even in Germany the case the interest was but transient. The turret guns of her battleships were arranged on the basis of the pre-dreadnought era and had unusually high elevation, 80 deg, at least, which probably gave them an exceptionally long range for their power. But when the first German dreadnoughts came to be built, their turret guns were given a maximum elevation of only 15 deg, nor was this increased in any of their later ships.

When going over the German battleship "Baden" after she had been surrendered three years ago, I was surprised to find that her 15-inch guns could not be elevated above 15 deg. This inverted the reports which had been current during the war, that our ships were invariably getting the better of theirs owing to the superior elevation of its guns; the real truth being that in the Jutland and the Dogger Bank actions our heavy guns operated at ranges at which the Germans could not reply.

The almost universal disregard of high elevation before the war was due to the fact that in improving the hitting power of the battle fleet the attention was almost entirely developing ranging power to an extent which was thought to be far beyond the scope of the war. The maximum range was always thought of as within the 15,000-yard limit, and as most modern big guns gave this range with a gun speed of 1,000 ft. per second, it was accepted as a standard.

No military officer doubted that the maximum elevation of British naval guns. The battleships of the "St. Vincent" class, built in 1903, which first carried the powerful 12-inch Mark XI 50-caliber gun, attained a range of over 20,000 yards with their extreme elevation of 15 deg. With the adoption of the 15.5-inch gun for the "Vintons" class, with a lower muzzle velocity, it was evidently most necessary, in order to maintain the required standard range, to provide for an elevation of 20 deg. This maximum angle was maintained when changing over to the 15-inch caliber, mounted in the "Queen Elizabeth" class, and the 15-inch gun, with its maximum range of over 24,000 yards was achieved. During the war the days of the war, the value of very high angles of elevation was demonstrated.

The German fleet, however, had accepted a range of 10,000 yards; at the Falkland Islands battle the Germans managed to get into a range of 10,000 yards. Presumably this success was due to give the guns of the four new battle cruisers of the "Hood" class a 10-deg elevation, which would give them a range of 20,000 yards. This was done, but, as at the armistice, three of the four new ships were scrapped, and the "Hood" herself remains, carrying guns identical with those of the "Queen Elizabeth" class. Presumably this was due to 20-deg elevation. No alteration has been made in any other British gun turret.

In the "Hood" therefore, disadvantages have undoubtedly been accepted to obtain the extra 10-deg elevation, but it may well be questioned whether the gains compensate for them. It is obvious that, as each gun and its mount swings through an extra 10 deg, the weight of the turret and its mounting is increased. A longer elevating screw or cylinder is necessary, as is a larger gun port and larger slide rails. Extra power is needed to move the turret through the extra 10-deg when loading at 30 deg; and to raise the muzzle braces—discharge which would not, of course, arise in the case of the "Queen Elizabeth" which was understood to have 25-deg elevation. And extra stiffness may have to be provided to take the greater (Continued on page 72)

ELEVATION AND RANGE OF UNITED STATES AND BRITISH GUNS

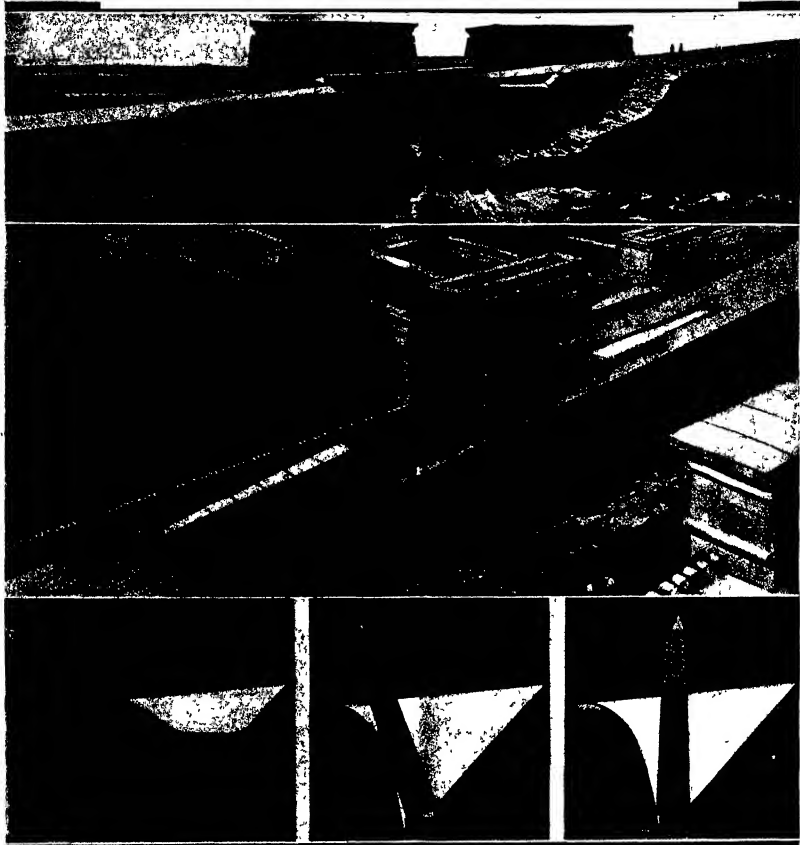
U. S. NAVY

No. of Ships	Caliber of Gun	Length of Gun in Calibers	Elevation of Gun in Degrees	Hyd. Press.
2 Battleships	14"	80	80	23,000
4 Battleships	14"	80	15	23,000
2 Battleships	14"	80	15	23,000
2 Battleships	15"	80	15	23,000
2 Battleships	15"	45	15	23,000

BRITISH NAVY

No. of Ships	Caliber of Gun	Length of Gun in Calibers	Elevation of Gun in Degrees	Hyd. Press.
2 Battleships	15"	45	80	23,000
1 Battleship	15"	45	80	23,000
4 Battleships	15.5"	45	80	23,000
1 Battleship	15.5"	45	80	23,000
1 Battleship	15.5"	45	80	23,000
1 Battleship	15.5"	45	80	23,000

posed to accepting certain positive disadvantages for the sake of obtaining high-angle fire. The chief disadvantage was one which had operated in all stages of artillery development, with the truck gun as well as with the turret, viz., the necessity for a larger gun port. In a turret the guns project through their armor walls, and to allow them to be elevated and depressed large elongated holes have to be cut, leaving unprotected gaps. The higher the range of elevation, the greater these gaps must be, and although they may be covered or filled by screens or sliding plates of armor, they still remain as highly vulnerable patches, "weak points" in the armor of the gun turret. How to in-



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THE question of the mechanical means by which the ancient Egyptians set up their huge obelisks, often in a court shorter than the obelisk itself, has long been a mystery. Cleopatra's Needle is 68½ feet high, 8 feet wide at base, and weighs 180 tons. An Egyptian obelisk saw at St. John Lateran in Rome is 106 feet high, 9 feet wide at base, and weighs 430 tons. Still more enormous is the obelisk, never raised, which was recently unearthed lying horizontally in a granite bed at Assuan. It is 138 feet long and 14 feet wide at

base. Its weight is carefully estimated at 1105 tons. It has remained for the Chief Inspector of Antiquities in Upper Egypt, Mr. R. Lepsius, to suggest the above solution of the obelisk raising problem, based on references in Egyptian papyri to a sloping brick embankment or ramp 400 yards long by 35 yards wide, and the use of sand in making it, also to the known use of levers and rollers, ropes, and the employment of thousands of slaves. The obelisk was not raised, but lowered into a funnel-shaped sand-pit dug in the ramp over the spot

where it was to stand. It was hauled up the ramp on rollers until its base lay over the sand pit. The sand was then gradually withdrawn through channels below, and as it ran out the obelisk sank into the requisite vertical position. The three lower diagrams indicate, in the order shown, the sand being removed from the pit, then the obelisk coming to rest, and lastly the obelisk pulled upright. This ingenious engineering idea may be typical after all, of how the Egyptians carried on much of their remarkable construction work.

OBELISK-RAISING EXPLAINED: HOW THE ANCIENT EGYPTIAN ENGINEERS EMPLOYED A SLOPING RAMP AND A SAND-PIT

Industry in the Philippines

The Golden Opportunity Which this Dependency Presents to American Capital

By Vicente Villaman

THE ECONOMIC progress of the Philippines since American occupation 23 years ago far surpasses that of the three centuries preceding it. It is marked by extension of the railroads, greater and more standardized production, modernization of processes and more coordination in management and marketing. The development of the country on a larger scale is a challenge to enterprise.

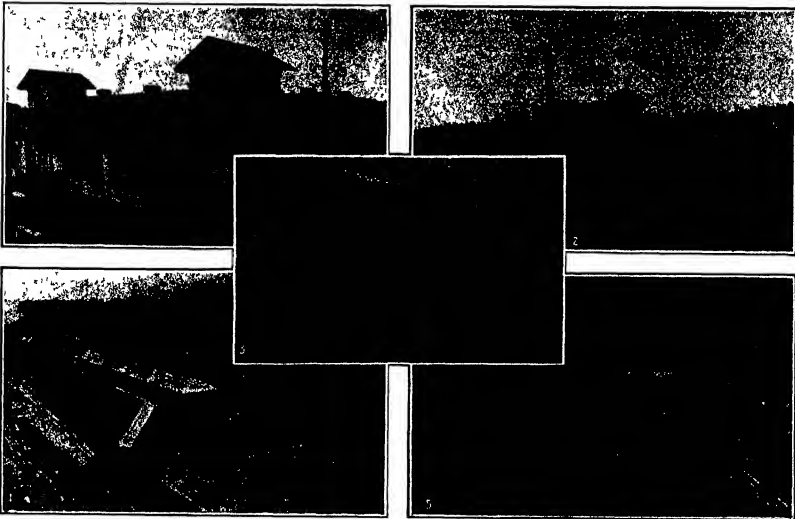
There are 7,000 islands in the Philippine group, which fact makes water transportation vital. There are 6,000 miles of good roads, 10,000 miles of telegraph lines and 100 miles of inter-island cables. Distant points in the archipelago are connected with Manila by radio. The outside world is reached by three cables and one wire-

less. In 1920, 21 per cent of the sugar produced was 90 degrees centrifugal and 70 per cent 88 degrees Mucavado, in the following year it was 96 per cent centrifugal and 64 per cent Mucavado. As modern methods are introduced more centrifugal sugar will be produced, which means more returns.

There are still a good number of animal driven mills and small steam-power mills furnished with side-train engines. The sugar out-turn of these mills is usually of low grade on account of discoloration by caramelization in kettles placed directly over the fire. The output of modern centrals compares well with the best of its kind in the New York market. There are now 32 of these centrals erected with a capacity of 20,000 tons of cane a day. The first central was built in 1910

charge the syrup into vacuum pans where it is boiled into crystals. Impurities remain in the mother liquor and are carried off as molasses. When the massecuite has been boiled to a proper density the contents of the vacuum pans are dropped into mixer tanks whence they go to centrifugal machines for drying. Molasses is finally separated from the crystals and the sugar is then sent to the bagging bin ready for export. The molasses is further subjected to a process of extraction, the residual molasses being used for making alcohol or cattle feed or burned for power.

The coconut oil is expressed from copra which is dried coconut meat. In 1918 there was only one mill in the islands and the export that year amounted to 5,000,000 kilos, while in 1919 there were in operation



1: Cash-house and main office building of the Manila Electric Company. 2: A typical sugar central in Luzon. 3: The current style in culture in Manila. 4: The laborer's quarters and (right fore-ground) the spray pond on a large sugar central. 5: Settling tanks, juice basins and evaporators which constitute part of the machinery of a sugar-cane reduction.

Glimpse of the industrial life of the Philippines

less system. There is a tonnage of 1,200,000 engaged in ocean shipping, while the aggregate of entrances and clearances in the coastwise service is 2,000,000 tons. The foreign trade totals \$225,000,000 yearly and the domestic business amounts to \$200,000,000. The archipelago has an area of 115,000 square miles with a population of 11,000,000. The total wealth of the country is estimated at \$5,000,000,000.

The Public Utility Commission has jurisdiction over three railroad systems, one street railway, one gas plant, 54 electric plants, eight water systems, forty telephone systems, two telegraph systems, 24 public wharves, 484 automotive vehicle lines and 138 steamers and steamship lines.

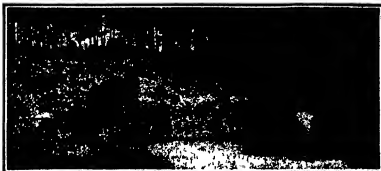
The first sugar shipment was made in 1706 when about 600,000 pounds were shipped to the United States. Development of this industry is already but rather slow, principally due to limited capital. In 1900 the export was 65,000,000 kilos, in 1922 it was over 800,000,000

on the island of Mindoro. The first shipment of cane trifurcal sugar, however, was made in 1914 from the San Carlos plant.

The cane goes on an endless moving platform into the crusher provided with rollers, from here the mat of cane passes to the milling plant proper consisting of a series of roller mills set in tandem. The cane there is then macerated by the application of water to obtain the maximum sucrose extraction, the fiber passing from mill to mill during this process. The juice obtained is subjected to a process of clarification. After being treated with milk lime to neutralize the acidity it is discharged into settling tanks to remove impurities and then decanted into the evaporator supply tank and from there pumped into caustic tanks whence it is again decanted and discharged into filter presses. The clarified juice contains about 85 per cent water and 15 per cent solid matter. About 75 per cent of the water is removed by multiple-effect evaporators, which dis-

charge the syrup into vacuum pans where it is boiled into crystals. Impurities remain in the mother liquor and are carried off as molasses. When the massecuite has been boiled to a proper density the contents of the vacuum pans are dropped into mixer tanks whence they go to centrifugal machines for drying. Molasses is finally separated from the crystals and the sugar is then sent to the bagging bin ready for export. The molasses is further subjected to a process of extraction, the residual molasses being used for making alcohol or cattle feed or burned for power.

After disintegrating the copra it is passed through grinders where it is converted into meal which then passes to the dryer where it is moved on belts under 220 degrees Fahrenheit for about 40 minutes, all surplus moisture escaping in a continued draft. The meal then finds its way into the oven for further tempering or cooking, being subjected here to a dry heat of about 100 deg. for 20 minutes or so, at the end of which time it goes to the expellers where it is ground by spiral square teeth. The oil, laden with impurities, flows off to receptacles whence, after separating foreign matter, it goes to filtering tanks for further clarification. From here it goes to storage tanks ready for shipment in deep



Using oil to rout the mosquitoes from the rock pile, their favorite breeding grounds

URINO minnows as mosquito collectors, digging huge drainage ditches that cost from \$30,000 to \$50,000 apiece, fighting the minute parasitic pests with oil and state-wide cleanup activities, mobilizing every agency of modern science to eliminate a menace and peril which jeopardizes the rapid settlement of the land of our last frontier—these are the effective measures that the Florida State Board of Health and manifold civil and private concerns are exercising most vigorously in freeing Florida of one of her most unwelcome guests, the objectionable, omnipresent mosquito, the minute whirler, of the insect world who delinquent in poking his prickly head into human flesh. Throughout Florida, the lowly mosquito that breed and swarm over regions of stagnant water have for many years acted the roles of winged "flycatchers," ever voracious for their tribute of blood. Floridians have now armed and united resources in the most determined campaign against the pestiferous "bloodsucker" ever waged in 1918.

The mosquito as an enemy to immigration and settlement and to sanitation and health is going to be eradicated from the land of flowers and winter sunshine before the armaments of science are again at sea. Florida has initiated a state-wide drive which will cease only when the winged stingers that have been a source of disease and nuisance have been permanently put to flight. Although at least 40 of the 500 known varieties of mosquitoes breed abundantly within the borders of Florida only four of them are feared as dangerous carriers of disease. Of this quartet of pestiferous mosquitoes, known scientifically as the anopheles tribe are the most objectionable, being the active disseminators of danger fever—initially which made temporary invalids of at least 20 per cent of the population of the southern States except Virginia and North Carolina last year. The disease is not fatal but it enervates and weakens the patients and markedly reduces their economic accomplishments.

This same anopheles mosquito is a virulent carrier of yellow fever in addition to being a foe of immigration. That is why all of Florida is now aroused and strident in a bonanza campaign to rout the pest. The average mosquito is a semi-animal maritime insect in that the minute fly cannot come into existence without water in which its various stages are passed. Hence the leading control measure is to eliminate the waterlogged bays and dens where mosquitoes may breed. In a State like Florida which has more than 30,000 lakes and a coast line that covers more than 1,200 miles, it appears to the layman impossible to control mosquitoes by eradicating such favorable breeding grounds. Experts report, however, that by practicing such controls in the vicinity of cities, the extensive dunes and have wrought by the pestiferous flies can be controlled practically. The distance that mosquitoes will fly from their place of origin depends largely on wind and weather conditions. In the brackish water sections of the Everglades, they have been found in large numbers inland 20 to 30 miles from the coast while in New Jersey, the bug bites have been discovered as far inland as 40 miles from the coast.

Mosquitoes breed in any standing water, even that in buckets or rain barrels which are often found in the neighborhood of human habitations. The female de-

ing process in the emergence of the new crop of mosquitoes is the manner in which the "wigglers" use the old skins of their pupa stages as rafts upon which they float about until they can stretch out their wings and fly away. If there is much movement of the water in the pupa stage, the mosquito will drown. That is why the insects seek slow moving or stagnant water as headquarters.

The larva and pupa of mosquitoes are air breathers. They are equipped with short breathing tubes that occur in the end of their tails, which they project through the surface of the water in order to obtain air

posts from 200 to 400 eggs at a time, which hatch out in from 20 to 48 hours. Generally speaking, from 10 to 20 days are required to complete the development of mosquitoes from egg to adult during the summer months. One interesting feature of the life cycle of mosquitoes is that the pupa stage is the most difficult to control.

sweep constantly in the desired amount from the can into the water, is another efficacious control. The can is usually suspended three feet above the water and the hole made large enough so that from 10 to 20 drops of oil will drip out at a minute.

Sevillita are numerous throughout Florida and seaweed is easily obtainable. The mosquito fighters have worked out another novel control system by soaking one hundred of seaweed in two gallons of oil for about 24 hours. The oil saturated seaweed is then "sown" over the water as one would scatter seeds over the ground. In some cases, burlap bags of oil-soaked seaweed are anchored in the stream in such a manner that they unit a stream of oil for some time which is effective in killing off myriads of dangerous mosquitoes. Oil-soaked sand dumped by the cartload into mosquito-contaminated streams also aids in the abolition of the winged invaders. The sand immediately sinks to the bottom of the water while for several days thereafter, bubbles of oil rise to the surface, burst and spread rapidly.

The ordinary minnow is worth \$1 apiece in preying on mosquitoes. The Floridians stock streams and pools with minnows and soon the busy swimmers eradicate the obnoxious colonies of mosquitoes. It is not unusual for a minnow to consume as many as 100 large mosquitoes in a single day. All that is necessary is that the water be free of lily pads, water hyacinths, matted grasses and other sources of obstruction which will prevent the minnows from penetrating to all parts of the ditch or stream.

Drainage is a permanent mosquito control measure that has proved most practical under Floridian conditions. At Perry, Fla., a community where 65 per cent of the population used to suffer from malaria, a \$30,000 drainage ditch was constructed some time ago which has eliminated the mosquitoes and the source of the malarial infections. The delivery of the community of Perry from the domination of disease-spreading mosquitoes has put new life into the town and has been the commercial making of the surrounding countryside which was a swampy waste during the supremacy of the mosquito monarchy.

The \$30,000 drainage ditch that has freed the community of Perry, Fla., from mosquito domination

This breathing method of the mosquito permits the practice of an efficient control measure which is being used largely throughout Florida. It consists in sprinkling or spraying a thin film of oil over the surface of the contaminated water. The mosquitoes are unable to push their breathing tubes through the oil film. Their air supply is thus shut off and they drown and die. The oiling system is most effective for treating small pools of water in ditches, ponds, streams, boat slips, crab holes, shallow lagoons, ice barrels and large containers of water. Oiling is a temporary measure and has to be practiced faithfully to secure desirable permanent results. The Florida State Board of Health has lined up the cooperation of all the agencies in the state. These service stations save all the oil that they drain from the creek cause of automobiles and give it to the State authorities for use in eradicating the pesky mosquitoes.

According to the Florida practices, oil is administered in knapsack sprayers, watering pots, drip barrels or cans, oil soaked sawdust or sand, and by mop or burlap sticks. The knapsack spray is the most efficient method of distribution medium. The supply can will hold five gallons of oil, the operator works hand pump and can shoot the oil in all directions a distance of 20 to 30 feet. The specially adapted in sitting the edges of ditches, streams and pools. The oil drip can, played along the course of a stream or ditch so that oil

Using the knapsack sprayer on the larvae of Miami, Fla., during the rainy season when the mosquitoes put their eggs. At the picture indicates Florida's rainy season flows up to its knees

Marine Wood Borers at Work

LIMONORIA is the name given by scientists to the species of marine borers to which these succulent-looking individuals belong. While the largest of these borers are only one-fourth inch long (they are shown here somewhat magnified), this rapid living pest is one of the most destructive of the wood destroyers found in salt water.

The *Limonoria* are found on both the Atlantic and Pacific coasts, subsisting on any untreated wood on which they may find lodgment, the piling in harbors affording one of their preferred opportunities for existence. Coming in contact with the piling through chance of tide or drift and lodging on the surface in crevices, the *Limonoria* start a system of interlocking burrows on the surface, eating away the softer springwood and leaving the harder wood in rib-like form. As the outer shell of the wood attacked is in this manner reduced to a spongy consistency, and is broken or washed away, the *Limonoria* penetrate deeper and deeper until in time the pile may be eaten almost through and snap off under its own weight.

Limonoria are especially hard to combat, owing to the fact that they will penetrate the impregnated portion of treated wood through the least crevice or abrasion and occasionally attack treated wood that has been leached out to a low toxicity.

The United States Forest Service and its subsidiary, the Forest Products Laboratory, are co-operating with other agencies in efforts to find effective chemical or mechanical treatment which will make piling immune to the attack of marine wood destroyers. This is one of the most interesting of the many fields of activity pursued by the Forest Service in promoting timber conservation.

Shop-Made Lawns by the Yard

NO longer need the impatient grower whose club is a newly organized one, or whose course has had to be renovated, wait weeks and months for the grass to grow to the point where the permanent greens may be used. Factory-made greens may now be bought by the yard, and laid down in their full velvety green. The same service is available for the tennis courts. A British "guy," J. MacDonald, of Harpenden, Hertfordshire, has perfected a method of sowing grass seed on a special fabric in a "factory" where the temperature is always that of spring or summer. Carrels of green grass are thus produced and when these are laid down on flattened surfaces, the fabric rolls away and the roots become incorporated with the soil. Lawns thus made can be played on in a very short time. Moreover, by a somewhat different method, a lawn for immediate play can be made. In this case the seed is sown into wooden trays with a fabric bottom. These can be



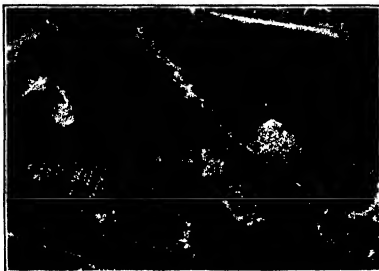
Cutting little lengths the factory-made grass carpets for golf greens and tennis lawns

transported in a rail and delivered locally, thus producing a green lawn that can even be laid down under cover. These same kind of lawns were employed during the World War for the camouflaging of gun emplacements and ammunition dumps.

How Sharp Is a Needle?

NO often hears the expression "As sharp as a tack," or "as sharp as a man's" but in nature this would be a very poor simile, as evidenced in the accompanying photograph of a bee stinger in comparison with the point of a very fine needle, magnified through a microscope 400 diameters. At this magnification it will be noticed that the needle is very blunt and rounded, and quite incapable of penetrating the skin while the stinger is perfectly smooth and still sharp. Further than this, something of the workmanship of nature will be realized by the fact that this stinger is not solid, as it would appear, but contains a duct or interior channel through which the poison secretion is injected into the possible victim.

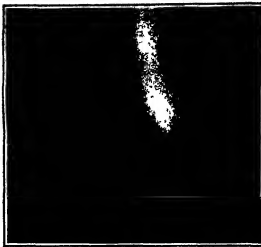
The poison is injected from two sacks or glands. The one known as the air gland is supposed to contain formic acid, the other as a secretion of alkaline, and it is the mixture of the two which forms the poison. It is this poison secretion injected into the flesh, and not the puncture of the stinger, which causes the intense pain with which the most of us are more or less familiar.



The thing that makes our wharves short-lived—a colony of wood borers at work, under a magnification of about fifteen diameters

Compressibility and the Size of Atoms

NO one of the most interesting subjects discussed at the meeting of the American Association for the Advancement of Science at Cambridge in December last was that of the size of atoms, especially as they exist in solids. Only a few years ago it was believed that the atoms in solids occupy only one-fourth to one-half the total volume of any material, but that each atom vibrates with a high frequency in the space between the adjacent atoms available for this purpose. It was supposed that in the compression of the solid the atoms are merely forced closer together, without any distortion of the atoms themselves. About 15 years ago Professor T. W. Richards of Harvard University began to develop the distinctly novel idea that the atoms occupy most of the space in a solid and that in any considerable decrease of volume the atoms themselves are diminished in size. This gave rise to his celebrated theory of "compressible atoms." In 1921 Professor Richards showed that the dimensions of atoms could be calculated from the compressibilities of the solids in which they exist provided data are available for a set of compounds related to each other chemically in a sufficiently simple way. For example he obtained such data for fluorine, chlorine, bromine and iodine of lithium, sodium, potassium, rubidium and cesium. (Using an ingenious extrapolation to zero compressibility he was able to show that the values correspond to a diameter of 2.5 Angstrom units, or one millionth of a millimeter) for the chlorine atom in common salt and other similar compounds. The interesting feature of these results is that dimension of the atoms, especially those of the metals, proved to vary with the nature of the compound in which they are contained. Thus the sodium atom is smaller when combined with chlorine (as it is in common salt) for which it has a high affinity, than when it is united with



A needle point (left), and that of a bee's stinger, photographed at 400 diameters magnification to show the relative crudity of the former

bromine or iodine, for which its affinity is less. Professor Richards' most recent work has been to devise a new and more directly experimental method for calculating the dimensions of atoms, with the remarkable result that the values obtained are the same, within the limits of error, as those given by the older method. The new method depends upon the idea that the element sodium, under compression exactly as potassium would act under high pressure. The attractive forces between the atoms is such that the internal pressure in sodium under ordinary conditions is 20,000 atmospheres higher than that in potassium. By using the data on these two elements he is able to show how the contraction which must take place in the formation of a salt from the elements may be distributed between them. The results throw much light upon the mechanism of chemical combination, the magnitude of the internal pressures involved and many allied phenomena.

The Present Conception of Matter

IT is probable that in the stars there is going on a transmutation of the elements, more complex ones being built out of the atoms of hydrogen, the simplest of all, while others are themselves being disintegrating. And what is going on upon our planet in the stars has actually been accomplished artificially in the last year or two by Sir Ernest Rutherford in the Cavendish Laboratory at Cambridge. Although the total amount of radioactive energy he has liberated have been minute, they are enormous when compared with the quantities of matter affected, but it must be added that there is no evidence that we may tap these stores of power.

It is for such reason that during the last few years, our conception of the nature of matter has entirely changed. The nineteenth century depicted the busy dance of the molecules. New elements were continually being discovered and the more exact investigation became the more likely did it appear that these elements and their previous relations to the ultimate materials of the universe. More than 90 elements have been known. Mendeleeff had found it possible to arrange a periodic scheme by means of which unknown elements could be predicted to fill the blank spaces in the table, and subsequent discovery showed how accurately this prediction was made. But the elements of the twentieth century came the greatest change. From many side attacks were made on the idea of the mutual independence of the elements each of which had been supposed to possess precise and certain characteristics. It was shown that the elements themselves which the atoms were not all exactly alike although the different specimens of such elements were chemically indistinguishable from one another. The element named "isotope" by Professor Soddy. Lead, for example, is one of these. This substance may be obtained in several different ways, its chemical behavior is always lead, but its atomic weight depends on the way in which it was derived.



Setting the 3300-pound capstone, Dec. 6, 1884. The staging is supported from the windows on each face

This view was taken when the surface soil had been removed, uncovering the original rubble stone foundation, preparatory to underpinning

The old foundation was cut away and concrete buttresses built in, piece-meal, without any cracking of the upper masonry

Underpinning the Washington Monument

Enlarging the Foundations to Carry the Five Hundred and Fifty-Foot Shaft

IF THE Washington Monument had been built in the days of the ancients, it would have formed, doubtless, the eighth wonder of the world. Even today, in this age of our concrete time, it stands unrivaled in the class of obelisks to which it belongs.

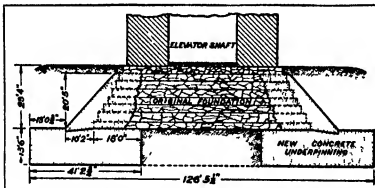
Among the millions of American citizens who have looked upon this noble memorial to George Washington, very few are familiar with the story of its creation, and we owe it to Capt. D. L. Went of the Corps of Engineers, United States Army, writing in the last issue of the *Military Engineer*, that the following account of the erection of the monument had been made public. The following article is based upon his most interesting story and in the above unadorned journal we are indebted for our illustrations.

The first movement in the direction of building a monument in Washington, was made in 1793, when the Continental Congress authorized the erection of an equestrian statue to be erected where the seat of Congress was situated. In 1793, L. B. Kent provided a location for the statue in the city of Washington.

Shortly after his death in December, 1790, Congress, on the motion of John Marshall, provided for the erection of a marble monument in Washington, and requested that the family permit his body to be deposited under it. The subject was brought up again in 1816, and in 1819 but nothing definite was done, although about this time a vault was prepared for Washington's remains beneath the floor of the crypt under the dome of the Capitol. James Buchanan in 1824 and President John Quincy Adams, in 1825, brought the question to the attention of Congress, but still no action was taken. So much for the remembrance and veneration of Congress.

Eight years later, in 1828, some influential citizens of Washington, hopeless, apparently, of any action by Congress, formed the Washington National Monument Society with Chief Justice John Marshall as president, and a campaign was started to secure funds. Three years later, designs for a monument to cost \$1,000,000 were invited, and the competition was won by Robert Mills, whose plans called for a circular colonnade building, 250 feet in diameter and 100 feet high with a 500-foot shaft rising from its center. The colonnade design was never adopted.

Twelve years later, in 1848, Congress authorized the society to erect a monu-



Cross-section showing the walls of shaft 15 feet thick, the original foundation, and the new concrete buttresses resting on a hollow, rectangular slab, measuring 126 ft. 6 1/2 inches on each side

ment to the memory of George Washington at the present site, and the corner stone was laid on July 4, 1848, at which time the society had collected \$88,000 towards defraying the estimated cost of \$1,000,000.

The foundation conditions were found to be good. The underlying strata was very compact, and at the depth of 25 feet, a solid bed of gravel six feet deep was encountered. The original foundation was 80 feet square at the base, 23 feet 4 inches deep, built in

pyramidal shape with the sides stepped, as shown in the illustration. It was built of blue granite, in blocks weighing from six to eight tons. The base of the monument proper, measured 55 feet 1 1/2 inches square, the walls at this point being 15 feet thick. The first 150 feet of the shaft were built with dressed white Maryland marble, and this height was reached in six years' time, or by 1854, when work ceased for lack of funds.

Five years passed and then, in 1859, Congress passed an Act incorporating the Washington National Monument Society for the purpose of completing the erection of the monument. The Secretary of War appointed Lieutenant J. C. Ives, Corps of Topographical Engineers, to superintend construction. He examined the foundation and reported that it was entirely satisfactory. Shortage of funds delayed the work, until Congress took action and appointed a committee to confer with the

society. This was in 1873, and in 1874, on the recommendation of Lieutenant W. P. Marshall, Corps of Engineers, later Chief of Engineers, it was decided that the height of the shaft should be reduced from 500 to 555 feet, so as to avoid excessive pressure on the soil of the foundation. It was not until August 2, 1876, that the thing was done which should have been done many decades before, for in that year, President Grant approved an Act which provided that the Government should take over and complete the erection of the monument, and that the Corps of Engineers should report on the sufficiency of the foundations. This board reported that the foundation was not sufficient to carry a shaft of the proposed height, and, thereupon, was undertaken the important work of underpinning the foundation, which is shown in the accompanying illustrations. This was done under the direction of Lieut. Colonel Thomas Lincoln Casey, afterwards Chief of Engineers. The trouble with the old foundation was that it was too shallow and covered an area insufficient to sustain the pressure which would come upon it when the shaft had been carried to its full height. The strengthening consisted in enlarging the foundation by spreading it over a greater area and sinking it to a greater depth into the earth.

By reference to our line drawing, showing a section through the foundation, it will be seen that, except for a central square 60 feet square below the old foundation, a massive square concrete slab, measuring 126 feet 6 1/2 inches on each side, and 15 feet 6 inches in thickness, was built below the original foundation. Start-

(Continued on page 75)



The underlying slab and sloping buttress completed, ready for rolling the soil to the base of the shaft

A Canal that Grows Crops in a Barren Country

ONE of the most curious canals in all creation is that now operated by Uncle Sam to carry the waters of the Malad River to southern Idaho to the King Hill Irrigation project in the Snake River Valley. Without water for irrigation, 17,000 acres of land in that neighborhood would be practically worthless. However, with plenty of moisture available, the locality will produce luxuriant and profitable yields of every crop that can be raised in the Temperate Zone. All fruits, early vegetables, grain and stock are the leading money crops. Due to favorable climatic conditions, the King Hill farmers can market early vegetables from two to three weeks ahead of any of their rivals.

The water of the Malad River is diverted into the canal at a point one mile above its mouth. The water is carried 400 feet through a large flume in the Canyon of the Malad. The main canal is 12 miles long, five feet deep and 8½ feet wide. It has four large bridges and siphons across the Snake River. Sixteen miles of the canal features concrete-lined banks, it being one of the most extensive of the western irrigation channels of a permanent nature. The Malad River is fed by springs so that it is a dependable source of water. The yield of water throughout the irrigation season, which lasts 100 days is adequate. Plans are now under way to construct emergency water storages in sources of emergency moisture during abnormal seasons.

The irrigation of the Snake River Valley has not only provided homes for a great number of citizens who, otherwise, would have been unable to obtain firm homes, but it has also created taxable values in excess of the entire cost of the project. A permanent character and will endure and be a perpetual benefit to the community, State and Government. The course of the canal is very crooked and tortuous, as is shown by the fact that the waterway extends over a route of 82 miles in providing arable rainfall to but 17,000 acres of farming land. More than five miles of wooden flumes have been replaced recently by concrete flumes and siphons. These improvements are practically everlasting, while wooden construction runs out in about ten years.

The King Hill Canal is in twetting, inasmuch as after the private company that originally owned it failed, Uncle Sam took control of the water plant, spent over a million dollars in improving it and now has developed it into one of the best small water projects in the Western States. He has built out the efficiency of the flow different types of concrete construction. The use of concrete, granite, granite, granite and concrete and concrete construction. Thus far the last three types have been most satisfactory. Where the topography is very steep and conditions do not permit of doing the concrete work directly at the scene of flow construction, the most practical system of building the flumes has proved practical. The concrete siphons are made in sections 12 feet long which weigh 3000 pounds apiece and then are joined together with sections of burlap soaked in tar. Altogether more than 17 siphons have had to be built

which range in diameter from 48 to 100 inches. The granite method of construction which features the use of cement guns for the deposition of the concrete as grout has proved particularly satisfactory under circumstances where any leakage of water which occurred might damage the foundation of the flume. The granite flume is very durable and weathers so that its walls are but 2½ inches thick. It can be built quickly and efficiently at lower unit and with less labor than

irrigated land for application to lighting and power. As will be seen from our illustration, the dam is being built in a series of great steps, and an interesting feature of the work is the method in which gravity is used in placing the concrete. As the dam rises above the level of the crest of the dam are large mixers which turn some 2000 tons of gravel, sand and cement into 1800 yards of concrete on every 1000 yards. From the mixers unitarian trains, driven by gasoline motors, carry the liquid concrete out upon the completed portion of the crest of the dam. From whence it is conveyed in a series of incline planes to the newly erected forms at the various levels of the finished work. The finished work is built in a lam-dred feet up the canyon against the dam, contains three turbine generators, each capable of producing 6000 horsepower.

Within the body of the dam itself are 4000 feet of auxiliary leading to valves which regulate the flow of irrigation water. These auxiliary extend in four local places.

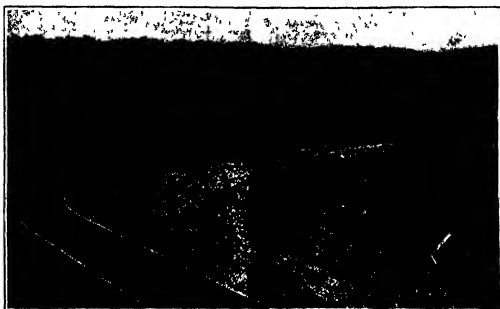
The lake above the dam will cover one of the historic spots of California's gold mine days. Don Pedro, a mining town from which thirteen million dollars worth of raw gold was shipped through the Wells Fargo express office, alone, cost fifteen hundred acres in 1861. J. L. Leland was elected President. The town was destroyed by fire in 1904 and the gold had been taken out by that time. It was never rebuilt, ultimately its site will be buried under 105 feet of water.

Quantum Mechanism in the Atom

At a meeting of the Royal Society of Edinburgh on May 8 Professor E. T. Whittaker read a paper on the quantum mechanism in the atom.

Professor Whittaker shows that it is possible to explain the complicated phenomena of the atom satisfactorily in terms of the classical electrodynamics without postulating any structure in the atom beyond that by which it is customary to explain the phenomena of induction. The author considers the effect of an revolving electron in producing a "magnetic current" in the atom, up to a certain velocity of rotation the electron does not get beyond the atom but suffers an "elastic impact" which repels it without loss of energy. When, however, the velocity of approach exceeds this critical value the electron passes through the atom, its atom and gives it its energy of exactly that amount or quantum which corresponds with the critical velocity. The transformation of this energy into radiant energy can be explained by assuming the magnetic current becomes equivalent to a charged condenser, parting of the nature of a Hertzian oscillator. By a simple mathematical process, combined with the assumption that the oscillations in the atom are similar to each other in structure and differ only in the equation $h\nu = U$ can be established, giving Planck's relation connecting the frequency ν of the emitted radiation with the amount of kinetic energy U of the revolving electron.

Photo-electric phenomena can be interpreted on the basis of this theory, and Bohr's theory of series spectra and other phenomena. Abstract from *American Journal of Science*, for July 1, 1922.



A piece of the 52-mile canal that carries the mountain waters of the spring-fed Malad River to the irrigated farms of the Snake River valley.

Harnessing the California River

ONE of the latest of the California irrigation works is represented by the Don Pedro dam which was completed very lately. The dam, which is situated ten miles above La Grange on the Tuolumne River, is believed to be the second highest irrigation



General view of the Don Pedro dam in California, said to be the second highest irrigation and power dam in the world.

and power dam in existence, overtopping the famous Roosevelt dam at Phoenix, Arizona, by several feet. It is 285 feet high, 177 feet thick at the base, 16 feet wide at the top, and 1000 feet in length. It will serve to create a reservoir covering 8270 acres, and will store 280,000 acre-feet of water and serve to irrigate 100,000 acres of what will prove to be highly productive land. Also, its waters will serve to develop 17,000 horsepower, which will be distributed among the owners of the

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1. In laying the tile it is extremely necessary that no outside or local reversal of slope be introduced. As tile of small diameter are sometimes laid on gradients as low as one foot, although this is unusual except in the case of turn tile, the accuracy of the gradient is more easily maintained by raising all the intervals between grades than it is when the runchers and the tile must be placed at uniform distances below. This shows the worst from the ditch, with an ordinary plow and two horses drawing from the opposite ends of a long row. 2. An endless chain type of trenching machine, with a revolving tile with the aid of an easily moved bracket that slides the ditch.

Equipment used in trenching and laying tile

Draining Land With Gasoline

How the Scarcity of Labor has Brought About the Use of Machinery for Marshland Ditching

By S. R. Winters

MARKING as recent of vast areas of over- and swamp lands subject to the nation facilities of private and general agencies, there are 43,573,000 acres of farming lands in twenty-eight American States whose crop-producing powers could be enhanced by drainage. According to sectional distribution, tile could be buried advantageously along an expanse of territory embracing 22,500,000 acres in ten Southern States, there being 8,000,000 acres of wet lands in Louisiana alone. In nine Western and Middle Western States underdrainage would quicken and increase crop yields on 12,300,000 acres, while in an equal number of Northern States trenching machinery would redound to the benefits of 8,417,000 acres.

This official compilation, data hitherto unpublished, is based on an investigation made by the Drainage Division Bureau of Public Roads, which serves to lighten interest in behalf of adequate drainage as well as to emphasize the achievements already credited to modern machinery and methods in removing excess water from agricultural areas. Over against the background of the compilation relating to the vast regions in need of the underdrainage is the encouraging accomplishment of ditching mechanism in four Middle West States—Ohio, Indiana, Illinois and Iowa—where the work has been so all-embracing as to render difficult any reliable calculation as to the untended farming in view. Progress in this group of States is unmistakable, and where accumulated moisture has not been displaced the agencies of organized effort are well on toward the execution of systematically defined plans. One county in one of these above-mentioned States supports 200 drainage districts, while still another

efficiently organized drainage districts of the Middle West, tile of five inch diameter is favored. The reason for the larger tile is obvious, inasmuch as any irregularity in the make-up of small sized drains for conveyance of the accumulated water is decreased in proportion. The variously shaped tiles of former days—distinctive among the types being the horseshoe tile with a flat bottom, either open or closed—have been superseded by those of a cylindrical shape, that is, with a round bore. In recent years, concrete tile has come into extensive use, its adaptation having been very widespread in the Middle West. However, the popularity of clay tile is not to be minimized.

The veteran ditcher—whose predilection for the use of the simple spade had its source in other hands than America—is fast disappearing, according to the drainage engineers of the Bureau of Public Roads. Attractive wages in the city, shortage of labor in more primitive occupations, and economic disturbances are probably the causes which have speeded the going of the immigrant who obtained his knowledge of the rudiments of ditching "in the old country." His departure has been capitalized upon by unskilled haphazardly worked at top speed, and the development of a multitude of the trenching machines, operated by steam or gasoline engines has been the fortunate result. Instead of the laborious hand method of installing a system for facilitating the flow of excess water, machinery digs the trench to the specified depth at a single operation. The types of implements vary from the inexpensive ditching plow, costing from \$20 to \$30, to the costly equipment designed for contractors and large plantation owners, entailing an investment of \$5000.

D. L. Yarnell, senior drainage engineer of the Division of Drainage Investigations, summarizes the three requirements of a good trenching machine. It should operate efficiently in all types of soils, should be capable of cutting true to grade, and should have the capacity for standing up under working periods of indefinite length without disarrangement or breakage. Hard shale, cemented gravel, sand, stones, loose loam, soft silt, and sticky clay, comprise the varied assortment of soils, for having a versatile equipment, it can be adapted to varying conditions. For instance, open or skimmer excavating buckets are best suited to sticky soils, while solid buckets perform efficiently in loose, dry soils. Obviously strength is a prerequisite for a machine that would labor in shale or stony ground—but the barrenness of its results should be like the scriptural sowing of seed, its efforts being non-productive.

According to classes, trenching outfits are four in kind—plows, scrapers, wheel excavators and endless chain excavators. The names of the first two betray their nature. They are operated by horses, and they frequently function simply to loosen the dirt in order to facilitate hand shoveling. "Wheel excavators" is a term which has reference to the fact that the buckets are arranged around the outside of a wheel, while the buckets on the endless chain type are conveyed on parallel endless chains supported by a long steel frame at the rear of the machine. One end of the frame is lowered so that the buckets are drawn upward toward the machine and thereby cutting a thin slice of earth from the bottom to the top of the trench. Scraper excavators are identical with the drag-line machines designed for wide ditches, being some-

insuring a widely cut.
The ditching plow is:

could not be afforded. The use of handwork is required to smooth the trench for laying the tile. The capacity of the ditching plow is frequently limited to the excavation of a trench of only 2 1/2 to 3 feet in depth, a depth not adequate in numerous localities. It is particularly a farm tool, serving the purpose of the farmer who desires to drain a portion of his land. The implement is powerless in extremely wet and heavy soils where horses cannot travel. The outstanding virtue of this type of equipment is contrast, with those of the elaborate excavator in its expense.

(Continued on page 72)

Marked innovations—although admittedly slow of evolution—have been inaugurated since the auspicious day in 1885 when John Johnston laid the first drain tile in the United States, the event taking place in Ontario County, New York. Significant it is that 34 years later—in the spring of 1919—but far removed from the spot where the historical tile-laying was commemorated, farmers pooled their interests, organized a company, and cooperatively acquired a power-trenching machine. The methods employed by Mr. Johnston are usually in vogue in this particular locality. Elsewhere a larger dimension of tile has been installed, the two-inch measurement having been abandoned for four-inch material while in the



A horse-drawn ditcher for shallow tile ditches

Concrete in Surprising Places

By employing the principle of the arch, large aero-sheds may be erected over a very simple manner by the use of reinforced concrete, and this method is especially applicable where it is required to construct aero-sheds having a considerable span. For already the question of the height of the structure is another factor which enters into the consideration. A good example of recent practice is shown in the large aero-shed which was built for the French Navy at Montebourg by the Poiré-Rhodés establishments, according to the plans of Eugène Lemaire. The outside dimensions of the structure are, length 500 feet, width 138 feet, and height 100 feet.

In principle, the portion which forms the vault is kept separate from the side or upright part of the structure, but to the eye, the whole has the appearance of a uniform construction, and as will be observed in our engraving, the principal members are spaced along the length of the shed and have a general parabolic shape. But for the sake of the principal members, the lower part consists in reality of a girder of triangular shape, having on the inside a straight or vertical beam, and on the outside an inclined beam, these being considerably spaced apart at the bottom to form the base of the structure, while they are brought together at the top, the whole being suitably cross-braced. On the top of this substantial girder which may be likened to a half-tower, is mounted the reinforced concrete beam which is curved into the general shape of the vault, and it rests on the base portion through the medium of a special joint of the kind which is now commonly employed for this class of structural work and termed semi-articulation, and in which the metal rods form practically the entire connection between the parts. The main girders of the structure being thus obtained they are cross-connected by the longitudinal portions which run along the whole length of the shed, then a special slab of reinforced concrete of light and strong make-up is laid over the space in order to cover the building.

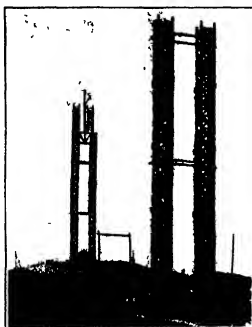
The triangular upright members are spaced in pairs at 80 feet representing the inside width of the shed, and have a spread of 20 feet 3 inches at the base. Both the straight and the inclined beams contain six web forcing bars of round iron. At the bottom of each is a good steel base of three feet three inches square the reinforcing bars passing down through the base and anchoring in a concrete foundation of five feet square. The uprights are molded and filled with concrete on the spot, being spaced about 10 feet 3 inches between centers, but the horizontal connecting beams are made up at the works, leaving the base projecting out at the ends of these pieces so as to be able to make connection with the vertical members while these latter are being formed. The cross members have a general square shape, but are given a channel bar section for the sake of lightness, the feet side being turned upwards, this portion having a small rib along the top and bottom spaced apart at six feet four inches on the height of the shed, these beams serve also to support the flat covering slabs. The top or arched portion of the shed consists of beams formed in parabolic shape and connected according to the beam members upon which they rest by the semi-articulations of other joint of the same character being provided at the top of the vault.

One of the original features of the new construction is the use of a large covering slab which was designed by M. Blaisard, and it is of unusual size, measuring 7 feet by 5 feet 5 inches. These reinforced concrete slabs were placed simply laid upon the structural beams after the main use of the customary reinforcement, they are very well adapted to receive a large surface



Outer and inner views of the end of an aero-shed of reinforced concrete, a recent French design.

girders to be covered, and may thus find numerous applications. There need no longer be any approximation as to an excessive weight of material when it comes to applying reinforced concrete for the sides and especially for the roofing of structures, and especially in the case of large sheds for airplanes or airships. A very light weight is obtained for the present type of roofing slabs. In spite of its large size it can be made



Another surprising application of reinforced concrete—in high radio towers.

as thin as 0.4 inch, and the metal reinforcing portion consists of wire gauze with very small mesh. As noticed in the sectional view, it is formed with a stiffening or ribbed portion along the sides and has two additional ribs of suitable shape at the middle part. The top and bottom parts are given a suitable shape for applying the slab upon two of the cross beams of the structure, this method being very simple and eco-

nomical. In order to facilitate the handling of the slab, which weighs about 250 pounds, the lower iron rod which is used for reinforcing the middle ribs is made to project somewhat at the top of the slab and has the shape of an eyelet, and this also aids in securing the slab to the cross beam. It is for the strength of these reinforced concrete slabs are made by supporting them at the ends and loading them over the whole surface with sand, representing the weight which the slab is required to support.

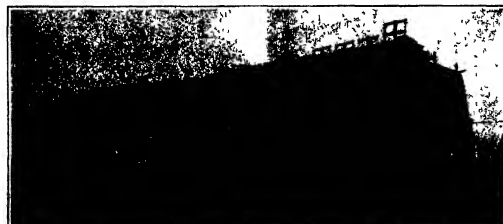
These interesting studies of the novel uses of reinforced concrete, which are in fact being added to almost every day. Just as a further example may be mentioned an other French development which involves the use of this type of structure for towers of extreme height. Radio towers especially are being built in this way, and are attractive in appearance as well as substantial. Ten tests will not blow them down, as was proved by some of the high towers erected at St. Pierre. What is a novel feature is that the tower can be made up, say, of 15-foot lengths, which are formed on the ground and then lowered into place. This means much quicker work than when a steel tower has to be built.

Poisoning by Illuminating Gas

THE only constituent of illuminating gas which has a serious poisonous property is carbon monoxide (carbon monoxide has the property of forming a dissociable compound with the haemoglobin of the blood just as haemoglobin has the property of forming a compound for haemoglobin is about 240 times that of oxygen for haemoglobin). The nature of the arterial to which the haemoglobin becomes combined with carbon monoxide the lower its capacity to unite with a carrier of oxygen between the lungs and the tissues of the body, and if a sufficient amount of the haemoglobin in the blood becomes combined with carbon monoxide the normal oxygen supply to the tissues must evidently be seriously affected. The effect is produced by severe carbon monoxide poisoning. In fact, these slabs of rapid application.

The minimum concentration of carbon monoxide that will prove fatal is not known with certainty, but the available clinical points to the conclusion that death will ensue after an exposure for several hours in air containing 0.1 per cent of the gas. Much depends on the length of time that the blood has been highly saturated with carbon monoxide, for the longer an exposure, the more the carbon monoxide is maintained the more serious is the damage to the tissues. The remedy, particularly in the severe cases, and the more the recovery. During this in fact it is not impossible that 0.1 per cent of carbon monoxide in the atmosphere might prove dangerous to life, in the case of prolonged exposure, according to H. B.

Exposure to relatively high concentrations of the gas leads, of course, to rapid loss of consciousness and death, but in accidental cases of poisoning the concentration of carbon monoxide in the air is usually relatively low, and in these circumstances the onset of symptoms will be gradual though progressive. For the gas, owing to its weight, will tend to collect in the lower part of the room, and it will be long before complete gaseous equilibrium can be established between the blood and the air in the lungs. Hence there is a great danger, for so insidious is the onset of the symptoms that the person affected may not realize that anything is amiss until he has lost so much of the power of his limbs as to render it impossible to withdraw from the danger. With 0.1 per cent of carbon monoxide in the air breathed a resting person will become disordered in about two hours and a half with 0.2 per cent in little more than an hour, and with 0.4 per cent in about half an hour.



The concrete aero-shed from the side, during the process of construction.



The well of Harod, where Gideon selected his brave

men after the end of the war, and center for research and advanced study. Sir Herbert Samuel, his Majesty's first High Commissioner for Palestine, created, as one of his first official acts, a Department of Antiquities for Palestine, charged with the protection of the historic monuments of the country, the arrangement of a national museum, and the organization and control of excavations and research. The Government properly regards the administration of the antiquities of Palestine as a trust confided to it by the whole world, accordingly, an International Board, of which the Director of Antiquities is Chairman, advises the Department on all matters of public interest. This board includes representatives of the national communities, and of the societies of foreign countries engaged in archaeological research in Palestine.

The first fruits of this new endeavor are now becoming visible. Professor John Garstang, D.Sc., of Liverpool University, gave through *The Illustrated London News*, an account of the progress of his forlorn research, and the protection given to ancient remains in the Holy Land, under the antebellum British regime. Professor Garstang is the organizing director of the British School of Archaeology in Jerusalem, and the Director of Antiquities for Palestine. He writes with the authority of scientific experience and those who may have entertained doubts as to how far political and other could exclude might afford Great Britain a full résumé of her trust in regard to the antiquities of the Holy Land, will be reassured and gratified by the professor's definite account.

Special monuments, like the great Crusader's Fortresses of Acre and Akko, the Roman city of Caesarea, and the Philistine site of Ashdod, have been put under guardianship, and museums are being organized where all the local remains may be preserved and studied. A central museum has been established in Jerusalem, with a distinguished Oxford graduate as keeper, and already the framework of a representative collection is open to the public.

It is in the field of excavation and research that the most noteworthy activity may be recorded. The new regulations may appear to be severe and meticulous, but in practice they are found to be a real safeguard against unscientific treasure-hunting, and while protecting the just rights of the national museum, they provide efficient help and encouragement to properly conducted expeditions, worked on behalf of societies whose academic and scientific status is unquestioned.

Our map shows the sites already being excavated, and those where work is pro-

Digging in Sacred Soil

Research With the Spade in Palestine Since the War

GREAT Britain has been to the full measure of her responsibility in Palestine, both as regards the protection of the historical monuments and sites and the organization and encouragement of research in the Holy Land. A British School of Archaeology (analogous to the other established institutions of Athens and at Rome) was founded in Jerusalem

last season. No fewer than eight properly equipped expeditions are at work and the results of this concerted effort promise to be far-reaching. On the eastern side, in the Jordan Valley, at Ain Dun, near Jericho, the French Archaeological School (Bosch Institute) conducted by the Dominicans Fathers has cleared and removed the protection of a mosaic pavement of an ancient synagogue of the third century. Hierobaths is the famous mound which marks the site of ancient Jericho. Considerable clearances were made here in the course of excavations made in other days, disclosing walls of undoubted antiquity, both those of houses and main walls of the city. But the historical interpretation of these researches is not complete. The excavation was not made with that due regard to minutiae which modern science demands, and there lacked then, as now sufficient comparative material, properly collated and arranged, by which to deduce the full and logical results from the work done. Doubtless some learned society will come forward in the future to undertake the task in a modern fashion. Further north is Jolan, the "Key to Palestine," dominating the junction of the valley of Jericho with

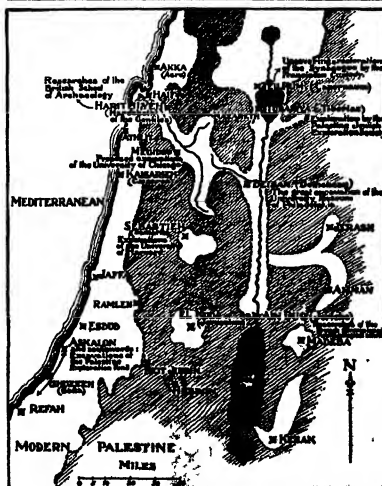
that of Jordan. Here the University Museum of Philadelphia has commenced work on a well-constructed site under the direction of Dr. Flannery, backed up by resources proportionate to the undertaking, and rewarded at once by historical discoveries. Further west, in the plain of Hadassah, in Megiddo, overlooking that most historic memory of which survives in the suggestive work Armageddon. Here the University of Chicago, at the instance of Professor Breasted, will

Part of the ancient wall of Jericho now uncovered

The views shown on the facing page are as follows:

1. The ancient town of Tiberias, on the Sea of Galilee. 2. Where Christ "entered into the synagogue and taught" in Capernaum. 3. Armageddon, the symbol of world conflict. 4. Where Samson carried away the gates and pulled down the temple of Dagon. 5. The port of Caesarea, the Roman capital of Palestine. 6. A field of biblical tradition, where the shield of Saul was "cast forth with all." The mountains of Gilboa, the Vale of Jericho, and the Jordan valley.

SOME HISTORIC SCENES IN PALESTINE THAT ARE NOW BEING LAID BARE BY PICK AND SHOVEL OF THE ARCHAEOLOGISTS



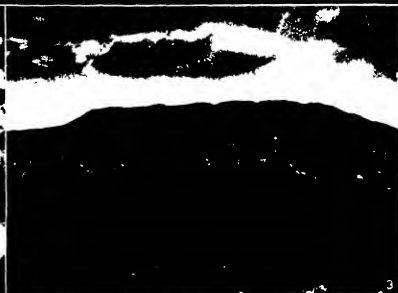
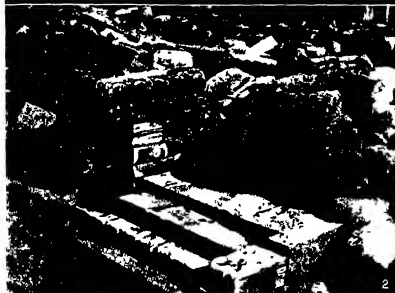
Sketch map of Palestine today, showing the points at which excavations are now being carried forward

The Palestine Exploration Fund has been engaged these two years on an extensive excavation at Ashdod, the ancient Philistine city, and this year that pioneer body will expand the area of its work and investigations to other Philistine sites in the vicinity, even as far as Gaza and southward, in order to obtain a proper and fuller interpretation from the historian's point of view of the very important evidence already recovered.

We may conclude this catalog of the present sites of excavation by reference to two upon the shores of Lake Tiberias (the Sea of Galilee) the interest of which is more local and the work unfinished. Just south of the modern town of Tiberias the young Palestine Jewish Exploration Fund is examining the ground beneath the lake, recovering evidences of the period of the Talmud in traces of ruins, inscriptions, amulets, and a profoundly interesting relic in stone reproducing crudely but in a well-defined manner the decoration of the seven-fold "candelstick," or Menorah, as described in the Book of Deuteronomy.

Recent visitors to Palestine the work which has been proceeding for some years near the head of the lake at Tell Ham, under the control and direction of the Latin "custody of the Holy Land" (ancient site desecrated from the Crusades), is that which appears as of modern interest and charm, alive from its character as a shrine, and as from the picturesque beauty of the scene and surroundings. For this is the site which corresponds to that of Caesarea.

The recent announcement that excavations are to be made at Jerusalem is a matter of the greatest interest, and the anxiety in local political circles at Jerusalem that it was heard that our own Government had been asked to undertake (without Government sanction) has forced a warring statement that the only sound as a scientific basis of ground called Holy City and that site still heretofore regarded as of no scientific interest to Christian Jews or Mohammedans.



Sawing Stones With Man-Made Stones

How Abrasives are Employed in Cutting and Shaping Marble and Granite for Building Purposes

By J. F. Springer

EXPERIENCE has shown that the use of the diamond in cutting marble and granite wastes more or less unusual. Similarly, corundum, aluminum oxide, etc., appear scarcely suitable when applied to the cutting and finishing of stone. Yet, one or more of the artificial abrasive materials have already gone into such service and are in daily commercial use. Big circular saws have inserted wheels of corundum, and saws that are used in the cutting of marble slabs and the like. Great planing machines are in use where big granite columns receive their flutes by the employment of similar wheels. Marble balusters are cut with accuracy and dispatch from rectangular blocks, corundum wheels being the active agent. Glass itself is very hard, but it yields to the modern abrasives. In fact, the cut glass industry is just about dependent upon abrasive wheels for the production of its designs.

Most uses of abrasives call for high speeds. The particles of hard and angular materials are so rigidly held on the periphery of the saw. The cut is secured largely by the velocity with which the particles meet the work. It is almost, but not quite, as if the bits of abrasive were little projectiles. However, a projectile depends solely upon its own momentum, whereas the abrasive particle depends partly upon the backing of the matrix in which it is set, as well as upon the momentum possessed by it. Since the weight is quite insignificant, this momentum is due largely to the velocity. Consequently, in order that a small particle, held more or less loosely, shall really have a substantial momentum, a considerable linear speed is necessary.

The standard linear speeds run, from 5000 to 10,000 feet per minute. This means that the periphery of abrasive meet the work at velocities roughly estimated at from one to two miles per minute.

A little reflection will perhaps suffice to show that such speeds require either a high number of rotations per minute (as with small wheels), or a large diameter of wheel, or a combination of considerable rotational speed and a moderate diameter.

Perhaps the use of corundum inserted tooth saws constitutes the most notable of recent advances. There is, first of all, a diet of steel. This may have a diameter as small as 40 inches or as large as 96 inches, or more. The linear speed at the periphery is properly 7000 feet per minute. This can be produced at the very moderate rotational speed of 318 r.p.m. If the effective diameter is seven feet, driven with an effective diameter of 2½ feet, the r.p.m. required will only be 801. However, the work in contemplation consists of the softer stones, such as marble, limestone, sandstone. I do not know that granite is commercially cut by inserted tooth saws. Whenever this operation is practicable, the linear peripheral speed will doubtless have to be increased, say, to 10,000 feet per minute. In fact, the necessity for such high speeds may be the real reason that saws for the cutting of granite stop yet in the future.

The business part of the inserted tooth is of a very plain shape, its form being rectangular. These rectangular portions project beyond the periphery, while the basal portion lies within the circular outline of the steel disk, that is, it is set in a notch made for it in the steel. The bases turn outward on both sides. The notches also widen outward from the rim toward the center. Notch and tooth are so related that the tooth engages set in position in the notch and then, held by a wedge which tends to force the tooth radially outward. The teeth, and especially the pro-

jecting portions are flat. They come in two or three sizes. A steel disk is designed that with the teeth inserted it will have a diameter of 80 inches, will have 16 large teeth or 32 small ones. A new 48 inches in diameter wheel with the teeth are set will accommodate 26 large teeth or 40 small ones. A large saw such as this, when running with a linear peripheral speed of 7000 feet per minute, will be rotating at about 327 r.p.m. With 26 large teeth around its circumference, 13,000 teeth will pass a given point per minute. With the 40 small teeth, we should have, under the same conditions, 22,900 teeth passing per minute. In this latter case, 871 teeth will fly by during each second.

If we know the speed with which the work advances, we may readily calculate the number of teeth which will operate on the stone per linear inch of advance. Such saws as I have been describing are adapted to cut from 4 to 30 inches thick. Suppose the work is eight inches thick, the molding wheel is set at the rate of 12 inches per minute. This would be one and one-third inches per second, or 871 teeth passing per second, the one inch cut would be made by the action of 1805 teeth. This rate of 1805 teeth that the molding wheel set at the rate of 12 inches per minute. This would be one and one-third inches per second, or 871 teeth passing per second, the one inch cut would be made by the action of 1805 teeth.

In 1925 separate cuts were made in making an advance one inch long and eight inches high. Each square inch of this advance would be accomplished by 292 cuts. This means that the work accomplished by the passage of one tooth amounts to the removal of a cross-sectional bit of stone about one-fourth inch high and about one-fifth inch long.

It has already been said that the several teeth are held in position by wedges. Of a tooth are not parallel.

The forward end of the tooth is, in fact, not as deep (from top to bottom) as the rear end, the words "forward" and "rear" having reference to the direction of movement of the saw. The bottom of the slot is just about parallel with the top. Accordingly, the wedge is driven from front to rear. It is said that this method of securing the teeth is adequate in all conditions. No plastering is said to be required even when cutting fine moldings, fluted columns, etc. The teeth may be renewed and reinserted at will. The saws require but little mechanism for the successful operation. A machine built for using an abrasive wheel consisting of a steel central shaft and an outer rim of an abrasive set in a suitable matrix are suitable for saws having inserted teeth of corundum. Similarly, machines adapted to rotate diamond circular saws may be used for the later type of saw. Given, if the saw is single edged and is to be taken off after motion, the bed upon which the work is secured must be given a circular motion. Probably the inserted tooth saw can also be mounted in a swinging frame or in a frame capable to be retracted horizontally.

Balusters of marble and limestone are now being

made in considerable quantities by means of corundum wheels. In this process there are two methods of procedure. In the one, a machine analogous to the ordinary turning lathe is employed. The rectangular block of stone is properly mounted on the lathe, the lath is then rotated at about 100 r.p.m. A big molding wheel of corundum corundum, in this case, to the cutting tool of the ordinary lathe. This has a surface the exact reverse of that of the baluster. That is, if, when the job is done and while rotating wheel and finished baluster are yet in contact, a plane be passed through both axes, the region of contact will be one and the same line. Where the baluster bulges out, the molding wheel is cut in, and where the baluster is cut in, the molding wheel bulges out. This molding wheel may consist of a single piece, or it may be made up of a gang of separate wheels. It is operated at a high speed. Naturally, however, the linear peripheral speed will vary with the varying diameter. One may say that the molding wheel should be operated at such a rate as to give a linear peripheral speed of 3000 feet per minute, but this line of reasoning is a little open to question. It would be perfectly feasible, however, to say that the part where the diameter is at a minimum should have the least velocity, or that the place of average diameter should have it.

At any rate, the molding wheel is rotated at a sufficiently high rate and while thus in rapid action is slowly moved against the slowly rotating block. The machine is so designed as to provide a means of feeding the molding wheel into the block and thus forming the desired baluster. This machine differs from the ordinary turning lathe in that the cutting tool is rotated, the molding wheel is not. The work is now produced rather resembles the milling machine.

The cutting may be facilitated by dividing it into two parts. In the second, the molding wheel is slowly moved against the slowly rotating block. The machine is so designed as to provide a means of feeding the molding wheel into the block and thus forming the desired baluster. This machine differs from the ordinary turning lathe in that the cutting tool is rotated, the molding wheel is not. The work is now produced rather resembles the milling machine.

The balusters must naturally have ends perpendicular to the axis, and often the bands will have square sections. Sometimes, the block is rotated and squared before it is put into the lathe and given its complicated form. But these operations may be done with the abrasive wheel subsequently to the molding operation. The molding wheel is set at a rate of 12 inches per minute. This would be one and one-third inches per second, or 871 teeth passing per second, the one inch cut would be made by the action of 1805 teeth.

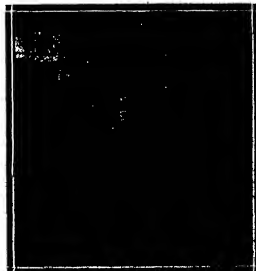
It is then run at a high speed. Naturally, however, the linear peripheral speed will vary with the varying diameter. One may say that the molding wheel should be operated at such a rate as to give a linear peripheral speed of 3000 feet per minute, but this line of reasoning is a little open to question. It would be perfectly feasible, however, to say that the part where the diameter is at a minimum should have the least velocity, or that the place of average diameter should have it.

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Inserted tooth saw in action. The peripheral speed is 5000-10,000 feet per minute.



Grinding a wheel, producing balusters. The work is controlled by means of a lever placed on the wheel.

The Airplane-Carrier "Langley"
WHEN the United States ship "Langley" joined the battle fleet of the United States Navy, she represented an old ship with a new name and an altogether new field of activity. It would take a naval man to recognize, in the "Langley" of 1923, the old "Jupiter" of 1912. Of the original ship, only the hull and the motive power remain. Otherwise, she is a new vessel; and, so far as her duties are concerned, it would be difficult to imagine a greater change than from the carrying of thousands of tons of gummy coal to the transportation of some thirty or more trim and dainty airplanes. In changing the ship over from collier to carrier, a clean sweep was made of all the structures above the upper deck, to make way for a broad, lofty and unobstructed flying deck. Gone are the tall masts and the long line of derricks for handling the coal. Gone also are the smoke stacks, and if someone who had never heard of airplane carriers, were suddenly to come upon the ship, she would look as though some giant carpenter had torn his plane over her superstructure and then built upon the ship a vast table as broad and long as the vessel itself.

The "Langley" will always carry, in the annals of the navy, the distinction of being the first large, seagoing airplane-carrier in the United States Navy, and to view the numerous importance which aviation is bound to assume in future naval strategy and tactics, this will be no mean distinction. There is another claim to historical value which is of scarcely less importance. We refer to the fact that when, as the "Jupiter," she was put into commission, this ship



The main deck of the Langley, showing on each side the latticed steel columns which carry the flying deck above

signaling radio masts which can be hoisted vertically below decks. To conduct the furnace gases away from the ship, two horizontal smoke ducts are provided, which are inter-connected so that the smoke can be discharged on the lee side of the vessel.

The large open space of the ship is available for storage of airplanes, spare parts, and the various equipment required by an airplane-carrier. There are mag-

netes which controlled the steering gear. It should be understood that this radio apparatus had no part in the original equipment of the "Jupiter." It was installed merely for target practice purposes. The "Jupiter," steaming at about 10 knots, and constantly changing course, was attacked at various ranges corresponding to those which would be obtained in a modern engagement. The ship was under perfect control.

Very interesting is the initial picture, showing the fall of a salvo of 14-inch shells during the bombardment of the old "Jupiter"—a ship which took part in the battle of Manila during the Spanish War. Of course, there was no one aboard the target; and she was steered from a distant ship by radio. The shells were fired from the "Mississippi" and the "Jupiter" was the target.

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The splash of a salvo of 14-inch shells fired by the "Mississippi" against the "Iowa" (left). Ship in the foreground is observing the fall of the shells

carried a new type of motive power, the electric drive, which was destined to be so successful as to cause it to be adopted as the drive for all capital ships of our navy. A sister-ship to the "Neptune," built at the same time, was equipped with a mechanical gear drive, and the "Jupiter" showed such superior performance that, so far as the turbines and gears built into the "Neptune" were concerned, there was no question of the superior economy and all-around performance shown by the "Jupiter."

The "Langley" is 543 feet long over all, with a beam of 60 feet and a mean draft of about 28 feet. Her turbines and electric motors operate two screws and her speed on trial was 15 knots. Her original normal displacement was about 20,000 tons. She was launched in 1912, and converted to an airplane-carrier 1920-1921. In changing the ship over to a carrier, the structures above the main deck were removed and above this deck, along each side of the ship, was erected a series of lofty lattice steel columns with a series of transverse girders running across the width of the ship to carry the flying deck. The whole series of columns was strongly braced, both transversely and longitudinally, and upon them was built a flying deck 60 feet long with nothing projecting above its surface except two

lines for the ammunition of the guns carried by the ship and for the bombs to be dropped by the airplanes. The gasoline tanks have a capacity of nearly 600 tons, and there are also tanks for the large amount of lubricating oil which must be carried. The tanks are served by an elaborate pumping plant, which leads to the hangars and to the flying deck.

The cargo holds have been altered so as to give the maximum amount of space for the storage of airplanes, and the "Langley" is credited with carrying a dozen single-engine pursuit planes, a dozen two-engine spotting planes, four torpedo-dropping planes and six torpedo-bombers.

The illustration at the top of this page is taken on the main assembly deck below the flying deck. On each side will be noticed the lattice columns which carry the flying deck above. Attached to the girders which support

Firing on the "Iowa" took place on two days. On the first day the "Mississippi" fired her 16-inch, 50-caliber guns using thin-walled, high explosive projectiles. This firing took place at from 10,000 yards down to 8,000 yards. Later that same day the "Mississippi" fired at the "Iowa" with her 14-inch, 50-caliber guns using thin-walled, high explosive shells at an initial range of 10,000 yards, which was decreased during the run to approximately 8,000 yards. That night the "Mississippi" conducted a search operation using star shells to locate the "Iowa," but not firing upon her. On the second day, the "Mississippi" again fired upon the "Iowa" at from 10,000 to 15,000 yards with her 16-inch guns and the thin-walled shells. Later that day, she made a second run, and administered the final blow, sinking the "Iowa." On this run firing was again resumed at between 14,000 and 15,000 yards and six 16-inch shells were fired.



Airplane landing on the flying deck of the airplane carrier "Langley" at Ft. Ponce.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News

the cables at the top of the instrument and disconnect it from the voltmeter prods at the other end. As many as 80 distinct tests may be made with this instrument.

Radiant Heat and Steam for the Complexion

A MASK for the administration of radiant heat to the face and has a section with a steam generator for additional treatment with steam is the product of a New York manufacturer whose claim is that this combined treatment is highly beneficial to the skin. The mask is made of aluminum. It envelops the face, which receives the radiant heat from a 60-watt lamp reflected from the polished metal interior of the mask. At the same time steam is supplied from a generator which is heated electrically from any lamp socket.

Most skin diseases it is claimed, can be traced directly to the clogging of the pores which prevents the blood impurities from being expelled in the natural outlet by perspiration. This indirect matter then suppurates resulting in an eruption of pimples. The old method of using a saturated cotton on the face is both unsanitary and ineffective as it induces the same perspiration it is by the skin being only wetted. Moist heat such as is furnished by the mask stimulates the nerves and causes a dilation of the blood vessels. This brings about a sedative action which relieves tired nerves. Electric light from a white bulb destroys bacteria and acts as a tonic while blue light constricts the blood vessels, producing an anesthetic which gives a sense of comfort and ease.



Steam-heating the complexion

A Clock That Never Forgets

MANY people have trouble in remembering their appointments arising during their waking hours, and for this purpose the alarm clock idea has been extended to make possible and convenient a series of alarms or memory ticklers given as previously planned or chosen by the user. Such a clock, which is shown in the illustration now further than this for the man who after being reminded that there was something to be reminded of cannot think what it is, there is provision on the clock face for inserting a number of cards opposite the hours when the alarm is to ring, each bearing a note about what is to be remembered. Thus the owner of the device after being apprised by the bell that he has something to do, may look at the card and discover what was to be done. *—Copyright Mr. Willis. At 2 40 p.m. alarm clock tells what he has to do, and connects the card that he has written to it on the dial. Otherwise someone will no longer know what they forget.*

A voltmeter and ammeter for locating automobile troubles

A Combination Voltmeter and Ammeter

BY means of this combination voltmeter and ammeter any trouble in the electrical system of an automobile may be easily located. The instrument is a combination of five instruments—three voltmeters and two ammeters and it affords a means of measuring the voltage and current of any source usually found in automobile equipment. It is provided with ammeter leads with clips for instantaneous connection and voltmeter leads having prods. For special testing tests a carbon electrode is included. The scale has a zero center and reads in both directions so that the user may be read whichever way the leads are connected. The needle swings toward the terminal to which the positive side of the electrical circuit is connected.

The small button in the face of the instrument is used for connecting the needle exactly on zero. In making the voltmeter tests a small button at the right is used to tilt the line points to 7. In this position ammeter readings cannot be taken. Four terminals are placed at the bottom of the instrument. In making ammeter tests the small button at the right is pushed till the line points to 7. This indicates the moving coil to

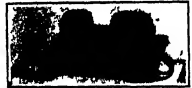


A voltmeter and ammeter for locating automobile troubles

to purchase butter for tomorrow's breakfast. But the clock will have served their customers before it is too late. This clock truly divides life into exact periods, and it will therefore meet with the wholesome approval of the very sober, pragmatic person who believes in a time for everything and everything in its time. It is a time for doing the work required in setting this clock. The card is simply inserted in the slot at the particular 15-minute interval the alarm is wanted. The card sets a lever inside the mechanism and sets off the alarm.

A Motor-Generator Charging Set for Radio and Automobile Batteries

A GOOD many people own radio or automobile batteries but have no means of recharging them. Here is a charging set for the wiring batteries of the car or for the A. batteries of the radio both of which have the good fortune to require the same voltage. The motor



Charge your own batteries from electric light circuit

part of this set which is the product of a Cleveland electrical manufacturer takes the regular 110-volt pressure at 60 cycles per second which means that it will suit the majority of electric light circuits in the U. S. A. The little D. C. generator gives current at 6 to 10 volts and is equipped with clips ready to attach to your cells for charging. The set is provided with test bearings at other end which peculiarly eliminates lubrication troubles.

Steel versus Rubber

AFORTUNE awaits the maker of a vehicle wheel which has such high merit that it will supplant the rubber-tired type now so almost universally in use. It is true that wheels enough to make a huge automobility of the Patent Office at Washington have been invented and patented yet despite all the effort thus represented the rubber tire, either pneumatic or solid rolls majestically on. Many of these wheels employ springs made for spokes but it has remained for Mr. W. B. Kerrie of Los Angeles, Calif., to use springs in the rim not a new feature either but in this case they are used in a truly unique manner. They take the load not in a diagonal but in a normal to the rim surface parallel to it. The wheel carries a steel disk into which the springs are set in large number of spiral springs having their axes as before mentioned parallel to the rim surface. These springs are also set into the inside of a rim having a channel cross-section. As the rim does not touch the disk, the load is entirely carried by the springs. These springs are only flexed on the many transverse springs. It is claimed that the use of steel does away with much vibration as well as saving fuel repair bills and so on, and that steel is not so sluggish as rubber disk will not longer



This instrument does many things

Electrical Etching, Demagnetizing and Annealing

AN etching instrument which can do many things three functions are the demagnetizing of a Toledo Ohio man's factory. In the process of the demagnetizing of tools which are used in connection with magnetic hucks, where it is necessary that the tools be kept demagnetized in order to be thoroughly efficient it is not necessary to pass them magnetically across the surface plate while an alternating current flows in the coils. The instrument receives its operating current from an ordinary light socket. When it is desired to stop the sole for instance it is only necessary to attach the pencil cord to the connection on the instrument and write with the ordinary touch on the tool. In addition to this the instrument may be used for light annealing and soldering. In the latter case a carbon annealing point is used in place of the etching pencil and the work to be annealed is held down to the surface plate with the magnet. In soldering the instrument is used in the same manner as for annealing. After the carbon point has been applied the solder is forced on in the usual way. The total weight is 20



Still another spring wheel



Directing traffic with the twinkling glove

points, so that it may easily be carried about a shop in any place where it is needed.

Stabilizing Carburetor Air
COMPLETE combustion of the fuel of an internal combustion engine depends upon the use of a correct amount of oxygen as proportioned to carbon and hydrogen. The fuel for such engines is usually a combination of gasoline and air. Gasoline is a fairly stable element of the mixture, but air, furnishing the necessary oxygen, is in constant variation and unless controlled to a practically uniform content and delivery of oxygen it disturbs three otherwise proportioned fuel elements, resulting in incomplete combustion with loss of power and waste of gas. Air contains oxygen in direct relation to its density. At high temperatures it rarefies and carries less oxygen to the engine, but if its density is decreased by artificial naturalization, its temperature lowers accordingly, and its fuel value is restored and uniformly maintained. Such artificial air saturation is accomplished, according to the claims of its Niagara Falls makers, by a device for that purpose, called an air stabilizer. As shown in the illustration, this appliance takes the air through its humidifying or saturating



A new attack on the miles-per-gallon problem

screens which are kept moistened by a flow of water which is aspirated drawn up from a basin by capillary action. This saturation increases the density of the atmosphere, reduces its temperature and restores its percentage of oxygen, delivering to the carburetor a supply of properly conditioned air. Fuel-larger savings in fuel consumption are claimed.

The Flashing Glove Hand
A GLOVE having attached to its back a pair of small electric bulbs, one red and one white, connected to a dry cell carried in a pouch on the gamutist of the glove is the clever invention of an Englishman, for the use of traffic policemen. Contacts are made by closing the finger next the color he both wanted. The signal is eminently practical because it becomes virtually a part of the policeman and is so quickly and easily manipulated that it finds constant use. There is very little about it to get out of order, or, like many devices employing electric lights in connection with the human form, to get in the way or be too heavy for comfort.

A Return to the Steam Motor Car

THE inventor of a new type of steam boiler for the automobile sees the use of gasoline for the self-propelled vehicle as only a temporary phase in the course of its development, while the steam propelled car, because of its comparative simplicity and homogeneity to outside disturbances, is destined ultimately to "come back." One of the chief troubles that beset the steam automobile boiler, especially in the hands of operators who are not familiar with its operation, is caused by an accumulation of mud from the injected water. This often quickens inside the water and prevents the part of the boiler which



This steam motor-car boiler cannot burn out
is not covered with water to reach a higher temperature than the ordinarily intended, the opening of the bottom part of water under pressure and leading to its burning out at such points. Mr. Walter D. Kierck of Los Angeles, the inventor of a boiler made to forestall such results, states that the vertical tubes of the new boiler are all welded into a ring shaped header at the bottom. Owing to the fact that this is below the level of the fire, when it gathers an accumulation of sediment it cannot burn out. The same principle is equally applicable to the locomotive boiler. It is stated that this new boiler has been given hard service during two years and has stood up in a remarkable manner, owing to its careful design.

Improving Radio Broadcasting

A yet no method has been found for a perfectly reproducing over a telephone transducer or microphone the overtones components of the human voice and of various orchestral instruments, like the violin, whose notes are

so rich in overtone. Numerous attempts have been made and the record of these represents a steady evolution toward the desired goal of perfection. The chief trouble with the metal diaphragm has been that it has too much inertia and too little flexibility to follow the rapid vibrations made by certain of the higher notes.

The new transmitter illustrated on this page is the product of research by Dr. Phillip Thomas of the Westinghouse Electric and Manufacturing Company. Its distinguishing characteristic is the use of a direct current glow discharge at low pressure, which provides a means of ionization conducive to ion open air. The application of a moderately high direct potential between two electrodes separated a short distance in air, with enough surface resistance to prevent formation of arc causes the establishment of a peculiar, low-current, high-voltage discharge having a glowing appearance. Such a discharge is remarkably quiet to the unaided ear. It is found that the incidence of sound waves at the gap will produce alternating potentials of equivalent frequencies. The sensitivity is surprisingly large, an amplification of ten



to one will give loud signals in a headset. Draft shields are used to exclude disturbing air currents.

Locating Defective Wires

ANY simple, though ingenious, method of locating either grounded circuits or broken wires in underground or concealed conduits has been devised by James E. Dehrick, assistant foreman of signals on the Pennsylvania Railroad. The device for this purpose consists of two iron rods about the size of walking sticks which are connected to the two leads from a telephone receiver. An alternating current or a pulsating direct current is applied to one end of the wire to be tested and the opposite terminal of this power supply is grounded. In case the circuit being tested happens to have an accidental ground along its length the circuit will be completed by this means and a current will flow. In testing the operator walks along the line and thrusts his two rods into the earth at points about a yard apart. As long as he is on the feed side of the ground in the power line, a noise will be heard in the telephone receiver. The tests are continued until the sounds cease. This indicates that the point of trouble has been passed for no current is now being picked up by the telephone terminals, these having passed beyond the return earth circuit. In a similar manner an open circuit will be located, owing to the fact that there is a continuous action between the wire and the earth which sets up a flow of current through the receiver.

A Distinctive Road Form

ROAD forms for making concrete cuts are usually made of metal, but there is often some annoyance connected with the method of joining the sections together firmly, as well as in the unhooking after the concrete has set.



A diaphragmless microphone for radio broadcasting

A Cleveland manufacturer has put on the market a form having a unique locking device designed to facilitate quick locking and unhooking. This consists of two very simple wedges so designed that it is impossible for the adjacent forms to get out of line on either their bottom or face. The lower wedge resembles a resulting frog such as is used on derrick railway trucks in that the upper wedge is almost bound to fall into the correct position with regard to the lower, no matter how carelessly they are brought together by the workman. This makes the sections of road form practically self-aligning and fool-proof, and facilitates the latter process of edging. The sections are 12 feet in length and are made of 8/16-inch stock. The flat holding surface have a penetration of 1/8 inches and may be driven in at any point along the edge of the form. The five-inch base of the form insures an ample bearing to support it when carrying mechanical finishing and subgrading machines during the progress of the usual road building operations.



The stepping, silent, low over, slender



This new machine grinds round holes accurately

A New Internal Grinding Machine

A NEW YORK maker of machine tools has placed on the market a new grinding machine, the invention of E. R. Bright, which embodies a new fundamental feature in the form of a revolving and reciprocating working spindle in one bearing, eliminating the necessity for its exact alignment with other essential parts of the machine. This makes possible great accuracy in the finishing of straight round holes. The machine is intended primarily for manufacturing operations and grinds cylindrical holes only.

The grinding wheel spindle is direct driven by means of an enclosed silent chain from a 1½ horsepower induction motor, thus avoiding all slippage and maintaining accurately the wheel speed. Owing to the vertical position of the spindle, floor space is conserved and the use of motor drive eliminates belts and shafting, which take up space. The machine has an automatic feed, but can be fed forward in units of one ten-thousandth of an inch. Provision is made for dressing the abrasive wheel by lowering it against a diamond. The base contains an oil-bath, with a pump for circulating the lubricant.

Roller Bearings for Railway Cars
WITHOUT the roller bearing itself it is not by any means new, its application to the immense amount of railway rolling stock in this country has



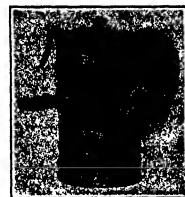
A roller-bearing roller bearing

awaited the perfection of a bearing that would stand up to the extremely heavy duty required for such work, and be as safe and as free from the necessity of making frequent repairs as the ordinary type of plain bearing. Such a bearing, as is shown here is applicable to use on flywheel shafts, heavy hoisting machinery and other similar work, but its great potential use is for the axles of rail way cars. Experiments are now being made which are rather in the nature of tests of a type of self-contained, self-aligning roller bearing for regular daily railway operation on one of our most prominent railroads. The bearing has held up in satisfactory condition after eleven months of such service. Ordinarily this would constitute a fairly conclusive test, but for railroad service extremely conservative criteria are necessary. Given practical roller bearings on our railway rolling stock, bearings that have long since passed the experimental stage and which have demonstrated their ability to take hard punishment, the saving in fuel and efficiency, not to speak of cost of freight movement, will be enormous.

This unique bearing, which is made by a New York manufacturer, is self-aligning by reason of its outer race which is ground spherical on its inner surface. The rollers are barrel-shaped, with their largest diameter toward the inner ends. This permits of great freedom of movement between the inner and outer rings, which are always concentric on their bearing surfaces.

Lights Without Matches

A MINNER who finds himself far from the shaft at the end of a drift without matches is almost as dead. If his candle miner's light has an automatic spark light its extinction is of no consequence—a quick motion of the



An automatic headlight with self-starter

hand, a spark is shot across the insulating scintilla gap and there is light. This is brought about by means of a flat and scraper. Such a light as this, which is made in Chicago, should be as valuable to night miners, woodmen, campers and farmers as to miners, because no matter how wet or windy the night the flint will ignite the gas. The light is primarily intended to be worn on the hat where it is always directed on the thing that claims the wearer's attention, but it may also be carried in the hand or worn on the front of the coat.

A Trackwalker's Kit
Track men who daily patrol his section of several railroad railway track is able to carry only a sponges and a long sponge. While these tools permit him to make most of the more urgent repairs necessary before the section gang arrives and completes the job, there are any conditions when the availability of a larger kit of tools would be of great advantage. But such a kit is al-

together too heavy for one man to carry. From Germany comes a solution of the matter in the form of a small truck such as is used by section gangs on our own railways for moving ties over short distances. Mounted on this truck is a large toolbox containing a collection of rail repairing tools as well as an assortment of bolts, nuts, lockwashers, plates and spikes. This avoided the necessity of keeping these articles distributed among at least twenty about the right of way, as is now done in this country, in order that when needed by the track walker he is fully sure of finding the desired replacement within a hundred yards of the job. These parts, when thus sprinkled along the track, are always subject to petty theft, as well as providing ammunition for boys with throwing popguns. When contained in the track truck they weigh one or two hundred pounds, but such a load may be pushed along the track by the track walker with less effort than that required for carrying the heavy manual and



Carries tools and spare parts for track repair

sponser. On the approach of a train it is only necessary to tip the foot truck completely over, emptying for this purpose the long lever ordinarily used to push the truck. The train having passed, the process is quickly reversed and the truck is again on the rails. It is provided with props so that the track walker may leave it standing when he stops to lounge or work.

A De-bouncer for the Car

A SHOCK absorber does not derive its desired function of "letting the rider down easy," but they must prevent the annoying upward which throws the rider into the air. Therefore they must act only on the upward motion of the springs, letting go instantly when the car body starts down. This function is well provided for in a type of shock absorber called a "chocker," made in Cleveland for a well-known type of car. A roller acts, in this case, between the moving and stationary parts, wedging them together on the upthrow and having no function on the down go. An adjustable spring presses down the flat wedge to the degree desired. The upper clamp is attached to the forward ends of the axle of the car and the lower one bolts around the front axle. No bolts need be drilled.

A Chemical Sponge for Refrigerators

A PIERCE of charcoal will absorb 8000 times its volume of gas and it is for this reason that charcoal is often taken for stomach trouble. Material having similar chemical properties is used by a New York manufacturer for filling a neat little chemical sponge for absorbent action in the refrigerator, where milk and butter will so quickly sour when the chemical sponge is not provided. The article lasts about one sea-



Absorbent had action in the refrigerator

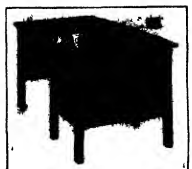
son, but is inexpensive. Where the ice is inure to it is impossible to keep the box perfectly wholesome between cleanings, no matter how frequent.

A Blueprint Dyer with Thermastatic Control

EXPERIMENTERS have proved that in order to pass wet blueprints through a dryer without wrinkling, it is necessary that the heat of the drying cylinder must be constant. This is a rather difficult thing, to accomplish in a perfect manner. Therefore the application of a thermastatic control to a blueprint machine by a Chicago manufacturer is a distinct step in advance. The thermastatic cannot forget. It might be said to "keep it's own fall asleep." It is sensitive to slight variations in temperature and catches them before they become so bad as to be harmful. The result is a blueprint of uniform texture and freedom from wrinkles. The machine has a copper cylinder which it is claimed, will heat quickly, retain the heat better, and to which the prints will not adhere but will peel off automatically. The sponge is made of asbestos and will not rot out because of wetness, like canvas sponges. The drive gives two speeds ahead, four and eight feet per minute, respectively.



A shock absorber on a different principle



This wastebasket attaches to your desk

Ball-bearings are used throughout, cutting operation costs and necessitating only a 1-horsepower motor. Gas or electricity may be used for heating.

Road Construction Turntable Speeds Up Truckwork

ON road building jobs, owing to the narrowness of the space between the subgrade, it is generally necessary for trucks which have delivered a load of material to back up several hundred feet, or else to turn under their own power in the narrow space, which operation usually damages the subgrade. In addition, when trucks meet there is great confusion owing to the small space for maneuvering. Therefore a turntable for turning trucks, which is made in Pittsburgh, meets a need. The turntable occupies a space of eight feet at one side of the road. In turning, one end and projects over the road surface. This means that an outgoing truck has free way to pass the turntable at all times, and that the forms remain in place regardless of the operation of the turntable. It is mounted on a skid which is enables it to be moved from place to place without tearing up the subgrade. The turntable is attached to a returner empty truck and moved the required distance without any loss of time.

A truck, after being driven on the turntable, is secured from tipping by supports at either end of the table. When the truck is ready to be turned a lever is operated which folds up these supports and then acts as a hand rail by means of which one man can turn a 5-ton truck loaded with 10 tons of material. The runways which support the truck are mounted on a circular track of smaller diameter than the width of the track. This track is placed immediately above a similar track rigidly secured to the skids. Between these tracks is a series of rollers so that there are no axles to cause friction. A roller pin rigidly secured to the skids which support the lower track holds a roller which keeps the rollers in place and also holds a central bearing for leveling the upper track properly centered.

Drying Negatives Without Clips

PUTTING a large number of negatives into ordinary clips for the purpose of drying them takes time and often damages the negatives by scratching them. It is much easier to plumb them between the coils of a long spiral spring made in a Pittsburgh manufacturer



A simple device for holding drying negatives

for this purpose. These have room for a large number of negatives and their insertion requires only a movement of the fingers in bending the spring.

A Waste Basket for Careless Marksmen

ONE of the most irritating habits of marksmen is to place themselves where they weren't, yesterday or the day before. The busy office worker without looking up, aims his waste paper where the basket ought to be and so the floor soon takes on the general appearance of a paper mill. To conquer all these annoyances a Westfield Mass. manufacturer has devised a wastebasket which may quickly be attached to the end of a desk, or, if desired, underneath it. Here it always stands or rather, hangs—and random shots at it hit the target because it is always there. The desk-end type shown in the illustration hangs from a small bracket attached to the under side of the desk top ledge. The under-desk type, which is not illustrated, hangs from a rod which has a spring, causing it to thrust its respective ends, which of which have a rubber tip, against the opposite sides of the space beneath the desk. The baskets are made of a single piece of sheet metal, and to the furnishing of bathrooms for clean and solid towels, of kitchens as catchalls for scraps and as receptacles for magazines and papers.



A practical turntable which saves time for the contractor

A Practical Scissors Sharpener

SHARPENING a pair of scissors can also be making a 90-degree cut across the edge of the blades, but it is very difficult to get the proper angle and other he given. However, it is necessary that the same angle be given along



With this guide anyone can sharpen scissors well

the entire length of the blade. In order to enable the action blades to be held at this angle, not only on one stroke of the sharpening but on every one. A Chicago manufacturer has put out a simple little device consisting of a piece of sheet metal bent in the form of a guide for the blade. This prevents the accidental ruining of the work, however carefully done without a guide, by a stroke at a greater angle with the side of the blade than the proper one. Added to these qualities is the unique fact that the device may be used in conjunction with any flat whetstone the user happens to have on hand. A woman can use this little sharpener as well as the average man, and a man can use it as well as a mechanic.

A Simple Seed Drill

FOR the average home garden a seed drill is often a luxury that cannot hardly be warranted by its small area, as well as an inconvenience owing to the two long handles held in the way at the ends of the short rows near the fence or wall. On the other hand, the dropping of seeds from the hand in a drill or trench is easily done poorly, but is with difficulty done well. It is as necessary to place the individual seeds somewhat uniformly and to drop them sharply instead of in dense groups as it is to use that no large gaps are left. The gardener often begins the sowing of a long row by hand with good intent.



A novel and practical seed-drill for the home gardener

lines of using care in order to forecast the results of the desired later on, but flashes with an impatient spark, for sowing the seeds evenly is very tedious. To prevent this, a seed drill which comes to us in the form of a photograph from



A handy shaving combination

Lather: Rub-It-In

WHEN the barber lathers you he rubs the lather in with his hands, but when you shave yourself and want to rub the lather in there is nothing to it but a sunny job—rub-in. Here is shown such a rub-in as shown in the picture. Here is a regular shaving brush which you proceed to use in the regular manner. Then, by manipulating a little slide in the handle, the brush is drawn into the shell, like a turkey's neck, and the lather is automatically squeezed out of the brush onto a rubber pad having down of little fingers. These do the rubbing. The little stud which actuates the brush in its tube locks in the desired position at either end.

A Non-Metallic Automobile Body

THEY recently has appeared a fabric type of automobile body which uses a wooden frame and disposed with metal panels altogether. A New York textile company has produced a waterproof material, the manner of which is applied over a wooden body framework dressed with a coarse wire fabric, the manner of which is applied to wooden rattles and squeals, as well as to fill out curve lines, etc. It is claimed for this new type of body, which has been shown at recent automobile shows, that the cost of the raw material is approximately one-half of that used in a metal body, that the time required in making a cloth body is one-third of that required in metal construction; that the cloth panels weigh only one-half as much as metal panels and that the finish is equal in smoothness, luster and brilliancy to that of a metal body. It is also claimed that the leather cloth lasts longer as regards finish than the usual finish of a metal job.

Radiant Type of Gas Heater

THAT the radiant type of heater was a first adapted to the use of gas is the contention of a reader of the SCIENTIFIC AMERICAN, who states that the first development of a radiant heater suitable for household use was made in England two or three years before the war. This heater was equipped with gas burners which heated to a high temperature a refractory material formed in the shape of a network surrounding a tubular space over each flame, and radiated the flame to incandescence. However, their manufacture was stopped by the war, the factories being taken over for war work. It is said that they are now in use all over the country.



An easy way to avoid tired wrists

A Clinging Grip on the Steering Wheel

A RUBBER grip for the steering wheel of a motor car permits the driver to retain full control of the car with little expenditure of energy, due to unconsciously gripping the wheel until the hands become tired and numb. This is especially true when the driver is wearing gloves, as the hands then slip very easily on the polished surface of the wheel. The rubber grip stretches around the wheel, fitting securely and resembling a new bicycle tire. It is made in Chicago.

The Service of the Chemist

A Department Devoted to Progress and Achievement in the Field of Applied Chemistry

Conducted by IMMAN DINBERG, Chemical Engineer

New Element, Hafnium, Discovered by English Chemist

AN English chemist has discovered a new element, which has been given the name hafnium. The element was isolated from a black sand, which came from New Zealand. This sand contained a certain proportion of titanium dioxide, and when this substance was removed from the sand and examined by itself, it was found to contain a refractory residue. Further examination of this residue revealed it to be an oxide of a new element, closely related to titanium. The name hafnium, which is derived from the name of the city of Copenhagen (hafnia), was given the new element. It is said that the black sand deposits in New Zealand, from which the sample of sand was taken which was used in the experiments, is more than seven miles in length and of unknown depth, so that if the new metal, hafnium, is found to have important commercial properties, it can be produced in bulk. It may be of considerable value in the making of incandescent lamps, as may be inferred from its analogy to the metals cerium and thorium.

New Steel

THIS English firm, Vickers, has produced a new steel, which has the following composition: 60 per cent nickel, 12 per cent of chromium, 2 per cent of manganese, 0.6 per cent of carbon and 20.1 per cent of iron. This nickel-chrome steel is not oxidizable in air or in rust. It was tested under the most severe conditions and was found to withstand corrosion under a pressure of 1000 atmospheres and a temperature of 600 degrees Centigrade, the duration of the test being 4000 hours.—*Chemist*, July 28, 1922, page 1136.

Process for Conserving Sandstone

AN interesting process for the conservation of sandstone, in which a silicate preparation was used, was described in the November 22 issue of the *Proceedings of the Royal Academy in London*.

Industrial Fuels From Acetylene

IN an address before the meeting of the French society, *Société de Chimie Industrielle*, Prof. A. Guyot gave an interesting paper on the industrial uses of acetylene starting with acetylene. Acetylene can be converted into methanol and paraffins. The latter is an important liquid fuel and should eventually reach a stage of great commercial importance because it can be produced more cheaply than alcohol derived from cellulose. Acetylene was also obtained out of that process were being studied on a semi-large scale to utilize the ethylene from ethane-oxide for the manufacture of alcohol.

Effect of High Pressures

Recent experiments have been made in Germany just what effect extremely high pressures would have, that is, pressures reaching to 50,000 atmospheres or approximately 800,000 pounds per square inch. The results of these experiments are being studied on a semi-large scale to utilize the ethylene from ethane-oxide for the manufacture of alcohol.

phosphorus becomes black, non-conducting and a good conductor of electricity. The new properties are stated to exist after the pressure is removed.—*Jour. Soc. Chem. Ind.*, 1923, page 80

Making Artificial Pearls and Precious Stones

ACCORDING to German Patent No. 550,938, the interior or black surface of the pearl or stone is treated with a suitable phosphorescent material, so that color changes are produced when the pearl or stone is taken into a dim light. For example, stones treated with zinc oxide containing radium exhibit a color similar to that of Guipin's pearls. In the case of glass pearls, the phosphorescent coating is protected by a transparent varnish against atmospheric effects, and the glass, if it is liable to be attacked by the radium compound, is bulkily protected.

Utilizing Oat and Peanut Hulls

THE manufacture of a large quantity of oat hulls and peanut hulls is obtained as by-products. These by-products are generally used as filler for stock feed, burned as fuel or allowed to go to waste. It has now been found that a sugar syrup can be obtained by hydrolyzing these by-products with two per cent of sulfuric acid for two hours at a pressure of 15 pounds per square inch. After hydrolysis the acid was neutralized with sodium carbonate and the sugar was removed by pressing and washing the insoluble residue. About 20.5 per cent of sugar was obtained from the oat hulls by this method and about 7.6 per cent from the peanut hulls.—*Jour. Ind. Eng. Chem.*, February, 1923.

Drying Wood

ONE of the greatest difficulties in the wood industry lies in the drying of the wood, the seasoning process. Wood is subjected to the action of the sun, the sun dries deep in the wood remain alive for a long time and a living cell does not easily lose its water. It can only lose its water after it has been killed by the action of a gas or vapor. Acetylenically dried wood is subjected to the action of the vapors of benzene in an autoclave. The article was killed in this manner and under the action of hot air the drying of this wood then took place very rapidly.—*Jour. Ind. Eng. Chem.*, February, 1923.

Fertilizing Forest Land

IT has been generally held that wooded land, land covered with forests, should not be fertilized for there would be no resulting increase in the growth of the trees. This has been shown to be erroneous, as treatment of such land with fertilizers containing nitrogen, potash, phosphoric acid and lime has increased the growth of trees in many cases. A test, extending over a period of 14 years, was carried out at Orting, Sigmaringen, on the edge of the Jura mountains, where a strip of land that contained only a few pine trees and juniper bushes was fertilized. The results were most interesting. The growth of the trees was increased two to three times for peatstraw was divided into two parts, one of which was treated with potassium nitrate and sulfuric acid with Swedish peat. Both parts were then planted with five and divided into sections some of which were completely

and others partially fertilized while others were left unfertilized. Between 1907 and 1920 the average increase in the height of the trees in the sections treated with potassium nitrate and sulfuric acid was 225 centimeters. In those treated with Swedish peat alone 513 centimeters, and in the untreated sections only 908 centimeters. Ground burnt by lightning it affected very little improvement in the growth. Trees in the sections planted with clover showed a very considerable increase in growth, especially in the first year, but the tests on the whole showed that equally good results may be obtained by the use of mixed fertilizers together with a previous crop of leguminous plants.—*Jour. Soc. Chem. Ind.*, Feb. 2, 1923

Paper From Black Butt Pulp

THIS pulp is made from a tree which is indigenous to Australia. Considerable experimentation has been done with this pulp in order to determine whether it is better adapted to use in the place of millie pulp, which at the present time is imported into Australia. It was found that 65 per cent of black butt pulp, 25 per cent of imported millie pulp and 10 per cent of waste paper made up a very good grade of cream colored laid paper. Black butt timber gives a higher yield of pulp per cord than any other wood in Australia at the present time for pulping purposes. Furthermore, the resulting paper is comparatively low—72¢.—*Eng'g Paper Trade Review*, Dec. 20, 1922

X-Rays Used to Activate Catalysts

WHAT appears to be a new use for X-rays or Roentgen rays is discussed in the *Zellulose für Elektrochemie*, 1922, pages 472-3. Platinum catalysts, such as are used in the contact process of making sulfuric acid, are subjected to the action of the rays. They are made more active so that the production of the acid is increased to a material degree. A 1-gram sample of 40 degrees Centigrade, for example the yield of sulfur trioxide increased from 4.6 to 50.9 per cent and at 200 degrees Centigrade from 3.5 to 71 per cent. The activation is not permanent but gradually disappears within 24 hours after the catalyst has been treated with the rays.

Frasing Inks

AN interesting account of inks and their elasticity is given in the *Anal. Chem.*, April, 1923, 129-30, *Chemical Abstracts*, 1923, 473. The only inkless inks are those containing carbon. It was found that solutions of potassium permanganate followed by sodium hypophosphite are much better ink erasers than sodium hypochlorite and oxalic acid, as are commonly used. The former eradicant will work on all the ink which the latter sometimes does not.

New Weapons for Boll Weevil Fighters

THIS fight against the cotton boll weevil, which causes tremendous damage to the cotton crop each year, the combat to exterminate the "billion dollar bug" has not yet been called, goes on unintermittently. Recently new weapons have been developed to assist in this perpetual battle. For one thing poison gases have

millitary weapons developed during the war, which are used for useful purposes in the warfare on the boll weevil. Another suggestion was the use of X-rays and gamma rays, which are applied by suitable mixtures to the bolls and squares of the cotton plants to sterilize the eggs of the insects.—*Ind. Point and Rep. Reporter*, Feb. 26, 1923.

Motor Fuel From Vegetable Oils

VEGETABLE oils can be converted easily into gaseous and liquid by distillations by subjecting the former to catalytic processes. The gaseous products are hydrogen, methane, etc., while the liquid products, after neutralization and hydrogenation, form a mixture containing appreciable amounts of benzene-toluene and meta-xylene. This forms a good motor fuel with a very appreciable odor.

Sugar Cane Alcohol, a Gasoline Substitute

ACCORDING to the *Oil, Point and Rep. Reporter* of March 26, 1923, sugar cane alcohol is used in South Africa as a substitute for gasoline. It is claimed to give more power than gasoline and to enable the engine to be started more easily. The motor will still start quickly in cold weather.

Self-Lubricating Gasoline

ACCORDING to the *Engineering World* March 1923, a self-lubricating gasoline has been developed in California which possesses certain advantageous properties to recommend it to the motor car owner. Ordinary lubricating oil is mixed with a chemical and then the treated material is added to the gasoline in the proportion of one gallon of the treated oil to 500 gallons of the gasoline. It is claimed that this product will increase the mileage obtained from a gallon of gasoline approximately 35 per cent. The lubricant is contained in the gasoline, penetrates every part of the gas engine cylinder and lubricates the upper parts of the cylinder, thus saving the oil from reaching the cylinder in the ordinary manner. As the mixture is a self-lubricating mixture and as the ethylene oxide of excessive heat and pre-ignition, no carbon is formed. It is claimed that the gasoline mixture develops perfect stoniness in the carburetor.

Crucible Steel in the Hearth Furnace

A HEARTH furnace which is capable of turning out a steel able to compete with high grade crucible steel, is the invention of a German engineer. The furnace has been installed in a foundry in Germany. A very high temperature is attained in the furnace by the joint action of heated hot air and gas generated in a producer. The gas is burnt rapidly in the hot air and the narrow flame coming from the white heat section of the producer. The whole content of the furnace are poured out into a large ladle raised to a white heat, which enables any sample up to 15 lbs. to be taken to test the steel. The sample melted without any premature cooling. The temperature and substantial steel structure obtained by the new process will in many cases be a good substitute for brass as well as complicated forgings.

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGE, U. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles.

Advantages of Bolted Chassis Parts

WHEN we remember that the frame work of the motor truck is really the foundation of the whole machine, it is surprising that so few manufacturers show any real evidence of applied engineering thought and effort. Practically any repair man will verify this by pointing out that the average chassis coming into his hands for overhauling is as weak as the proverbial huck. In a large measure this is directly traceable to the use of rivets throughout the frame assembly, and their inability to withstand the constant rocking and vibration of motor truck operation. As far as we know there are only one or two manufacturers who have given this phase of design the amount of attention it warrants. One of these, a Buffalo manufacturer and incidentally one of the pioneer motor truck manufacturers in this country, has been using a bolted frame with outstanding success for seven years.

In their method of fabrication all brackets, cross-members, supports, and in fact everything attached to the frame side rails is held in place by bolts and heavy type lock washers, as shown in accompanying illustration. The bolts are of ample size and fitted with threads which are held in very close contact to assure close fitting units. Actual service has proved through years of use and thousands of miles of travel that this method practically overcomes chassis loosening. And in event that play ever develops, it is a much more simple matter to draw up on a bolt or two than to chop out loose rivets, drill the next size larger holes and insert new rivets and rivet nuts.

Another point, which while of secondary importance in truck life is nevertheless a decided advantage, is the ease with which repairs can be made. For example, collision damage with bumper, fender brackets, bent step hangers or even damaged frame rails lends itself readily to dismantling and repair with a minimum of labor and expense for parts. The chief reason for this design has not been the economy adopted in the tendency of manufacturers to cut down their production costs in order to maintain the lowest possible selling price. Experience with motor trucks, however, will prove repeatedly that the cost of a motor truck is determined by its cost of operation rather than its initial purchase price. Therefore, this design is of particular interest because it goes such a long way toward eliminating this source of expense. To bear out the perfection of this design, the only passenger car using a bolted frame similar to that of the truck is a very costly English car.

Suggested Motor Truck Size Limit

SHALL dimensions, weights and speeds of motor vehicles be reduced to the capacity of the weakest highways and roads, or shall the roads be brought up to the standard of improved adequate roads, or shall the biggest, heaviest and swiftest loads that users of motor vehicles desire to put upon them? These are the questions asked by the Motor Vehicle Conference Committee in a digest of State laws in force on January 1, 1926, presented in a

pamphlet together with a suggested code of regulations for uniform State adoption.

The committee, composed of representatives from the American Automobile, Motor and Accessory Manufacturers and National Automobile Builders Associations, and the National Automobile Chamber of Commerce and the Rubber Association of America, believes that between the two extremes presented in the questions it asks a compromise will be found. This would affect the manufacturers in that they would design their products and highway engineers would build their roads in accordance with certain specifications evolved to meet the need. In regard to size restrictions the committee recommends a width, including load, of 66 inches height including load, of 12 feet 6 inches, length, including load, one vehicle is 30 feet, combination of vehicles, 50 feet. Weight restrictions—single unit, 5,000 pounds.

Why Trucks Should Be Loaded to

NO MORE in the history of the automotive industry it has become necessary for motor truck owners to plan maximum loads, if they are to care for the transportation needs of the country during the next year. It is



Details of the assembly of the bolted truck chassis

freely admitted that there is at the present time a shortage of freight cars not equal to the war time lack and during the next year this shortage of freight transportation facilities will not be reduced to any great extent. It is apparent, therefore, that for the motor truck, as before, will have to come to the aid of the railroads to meet a greater demand for movement of goods from all classes.

The railroads of the country are experiencing every influence to insure that that which is loaded to capacity will be loaded to capacity and that which is loaded to capacity will be loaded to capacity.

There are many truck owners who operate fleets, such as moving vans and cartage lines and trucks for hauling farm produce to city markets. In many cases these men are operating their trucks to full capacity in both directions. But there are some truck operators, perhaps many of these, who have forgotten the return load proposition of war time. A careful analysis of the transportation field will show them that even today we have reached such a stage in the railroad freight situation that it is impossible for business men to ship their goods by rail. The motor truck during 1928 can be of great aid in helping to solve this problem. It should be no trouble to secure certain special loads going and coming; if a little effort is made. When an effort is not only due the business of the country,

but it is also due the truck owners. They are doing themselves an injustice when they do not carry all the goods they need, not in both directions on every trip. And not only are they doing themselves and their business an injustice, but their own way loads are an equivalent loss that affects everybody in the price to the consumer.

Economy in Small Wheels and Large Tires

ANew development appears in the automotive industry in the small diameter wheel with the large over-size tire having its sponsors claim many advantages over the present sizes of pneumatic tires. It was pioneered by a Turkish manufacturing company of this country which has given it a thorough try in its testing laboratory and also in road service because the company operates more than 1000 vehicles. The car is built and equipped on a car per mile basis that is not unequal, it is said, to the automotive industry.

It was with this in view that two years ago the company started experimenting with the small diameter wheel and the large over-size tire. Today sales along the large main highways are equipped with a 20-inch wheel with a 22 x 4 tire. It is 45 or a 20 x 4-inch tire.

With this in view that two years ago the company started experimenting with the small diameter wheel and the large over-size tire. Today sales along the large main highways are equipped with a 20-inch wheel with a 22 x 4 tire. It is 45 or a 20 x 4-inch tire.

Several tire companies now manufacture these tires. In addition to these two sizes, the tire companies also manufacture a variety of sizes of big over-size tires. On a 20-inch rim the following tire sizes are available: 20 x 4, 20 x 4.5, 20 x 5, 20 x 5.5, 20 x 6, 20 x 6.5, 20 x 7, 20 x 7.5, 20 x 8, 20 x 8.5, 20 x 9, 20 x 9.5, 20 x 10, 20 x 10.5, 20 x 11, 20 x 11.5, 20 x 12, 20 x 12.5, 20 x 13, 20 x 13.5, 20 x 14, 20 x 14.5, 20 x 15, 20 x 15.5, 20 x 16, 20 x 16.5, 20 x 17, 20 x 17.5, 20 x 18, 20 x 18.5, 20 x 19, 20 x 19.5, 20 x 20, 20 x 20.5, 20 x 21, 20 x 21.5, 20 x 22, 20 x 22.5, 20 x 23, 20 x 23.5, 20 x 24, 20 x 24.5, 20 x 25, 20 x 25.5, 20 x 26, 20 x 26.5, 20 x 27, 20 x 27.5, 20 x 28, 20 x 28.5, 20 x 29, 20 x 29.5, 20 x 30, 20 x 30.5, 20 x 31, 20 x 31.5, 20 x 32, 20 x 32.5, 20 x 33, 20 x 33.5, 20 x 34, 20 x 34.5, 20 x 35, 20 x 35.5, 20 x 36, 20 x 36.5, 20 x 37, 20 x 37.5, 20 x 38, 20 x 38.5, 20 x 39, 20 x 39.5, 20 x 40, 20 x 40.5, 20 x 41, 20 x 41.5, 20 x 42, 20 x 42.5, 20 x 43, 20 x 43.5, 20 x 44, 20 x 44.5, 20 x 45, 20 x 45.5, 20 x 46, 20 x 46.5, 20 x 47, 20 x 47.5, 20 x 48, 20 x 48.5, 20 x 49, 20 x 49.5, 20 x 50, 20 x 50.5, 20 x 51, 20 x 51.5, 20 x 52, 20 x 52.5, 20 x 53, 20 x 53.5, 20 x 54, 20 x 54.5, 20 x 55, 20 x 55.5, 20 x 56, 20 x 56.5, 20 x 57, 20 x 57.5, 20 x 58, 20 x 58.5, 20 x 59, 20 x 59.5, 20 x 60, 20 x 60.5, 20 x 61, 20 x 61.5, 20 x 62, 20 x 62.5, 20 x 63, 20 x 63.5, 20 x 64, 20 x 64.5, 20 x 65, 20 x 65.5, 20 x 66, 20 x 66.5, 20 x 67, 20 x 67.5, 20 x 68, 20 x 68.5, 20 x 69, 20 x 69.5, 20 x 70, 20 x 70.5, 20 x 71, 20 x 71.5, 20 x 72, 20 x 72.5, 20 x 73, 20 x 73.5, 20 x 74, 20 x 74.5, 20 x 75, 20 x 75.5, 20 x 76, 20 x 76.5, 20 x 77, 20 x 77.5, 20 x 78, 20 x 78.5, 20 x 79, 20 x 79.5, 20 x 80, 20 x 80.5, 20 x 81, 20 x 81.5, 20 x 82, 20 x 82.5, 20 x 83, 20 x 83.5, 20 x 84, 20 x 84.5, 20 x 85, 20 x 85.5, 20 x 86, 20 x 86.5, 20 x 87, 20 x 87.5, 20 x 88, 20 x 88.5, 20 x 89, 20 x 89.5, 20 x 90, 20 x 90.5, 20 x 91, 20 x 91.5, 20 x 92, 20 x 92.5, 20 x 93, 20 x 93.5, 20 x 94, 20 x 94.5, 20 x 95, 20 x 95.5, 20 x 96, 20 x 96.5, 20 x 97, 20 x 97.5, 20 x 98, 20 x 98.5, 20 x 99, 20 x 99.5, 20 x 100, 20 x 100.5, 20 x 101, 20 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TORACOCO TREATING MACHINE.—**H. GUTMAN**, 941 So. Cherokee Ave., Oak Park, Ill. An object of this invention is to provide a process for the treatment of tobacco leaves, whereby the moisture for removing the stems and the seeds of the further use in manufacturing cigars, smoking tobacco, and the like, is obtained, thus effecting a considerable saving in the cost of manufacturing the article, but in time saved in the process.

AUTOMATIC OIL FEEDER FOR BULK-CORING MACHINES.—**M. MONROE**, c/o G. W. Corbett, 100 Broadway Street, N. Y. The invention relates particularly to an oiling device for use in connection with coring machines, and has for an object to provide a construction which is automatically self-acting as it passes through the machine, and works in such a manner that an even quantity of oil is applied to the oil spread throughout its entire length.

FRUIT GRABBER.—**I. H. FINE**, 1121 W. 56th St., Oakland, Calif. The particular object of the invention is to provide a continuous grabber for fruit, of large capacity for a comparatively small size. A further object is to provide a grabber that will handle cut fruit, as for instance peaches or pears, as effectively as whole fruit. A further object is to provide a grabber that will not damage the fruit in any way during the grabbing operation.

COFFIN MACHINE.—**W. H. HARR**, c/o H. H. Cotton Machine Co., Chicago, Ill. The invention relates more particularly to a new adapted machine in the manufacture of cotton to separate the cotton from the other material which is attached to it, as seed, such as hulls, seeds or foreign matter. The object is to provide a device of this character which is of simple construction, and comparatively low cost to manufacture.

MOLDING MACHINE.—**J. F. CALDWELL**, 726 So. Boone Ave., Los Angeles, Calif. This invention relates to a device adapted for use in the manufacture of various blocks and other articles of other exterior work. The object is to provide a simple and efficient machine in which the blocks upon being formed may be removed from the mold without the possibility of breaking or shattering the mold.

DAIRYING MACHINE.—**E. PRABHON**, Box 534, Littleton, N. H. An object of this invention is to provide a washing machine whereby having means for entering the finger of gloves and other pieces of work so that the same will be in proper position for washing. A further object is to provide a machine which may be readily and conveniently operated and which may be thrown to an inoperative position when not in use.

UNWRAPPING MACHINE.—**W. H. LEE**, c/o Turner Bros., 400 Ford St., New York, N. Y. This invention relates to a machine adapted for unwrapping various materials and other characters on a circular plate, and includes a means for transmitting energy a system used for tracing the desired character on the material. An object is to provide means to enable the operator to accurately place the letters or characters respectively of their size and shape, and to expose the same in a straight line or at an angle.

COIN WRAPPING DEVICE.—**J. L. PARKER**, Wadsworth, Ohio. The general object of this invention is to provide a simple and efficient device for wrapping coins which will operate quickly and will produce a neat package. The object is accomplished by providing a device including a means for wrapping the coins into a cylindrical form, and supporting the same in connection with a coin guiding means.

SHUTTLE PRESSURE INDICATOR.—**J. J. MCCONNELL**, W. J. McCann, 1017 N. J. Among the objects of the invention is to provide a device which is an indicator that may be mounted in a shuttle to record the strength of the stroke delivered by the picker stroke, and to provide for guiding the operator in squaring the stroke and in adjusting the pressure to give the required stroke, thus greatly reducing the waste and loss of time.

OIL WELL DRILLING MACHINE.—**E. C. SHAWNEER**, c/o Oil City Iron Works, Erie, Pa. An object of this invention is to provide a drilling machine whereby the use of the same may be reduced to a minimum, and the cost of the same may be reduced.

with relation to the other machines. A further object is to provide a machine embodying inner and outer tables and means for holding the same both against rotation and translation, whereby the table which is operatively connected with the outer table may be turned with relation to the lower section of the table without rotation.

UPPER AND LOWER RING.—**J. CRAWFORD**, 5838 E. Green Lake Ave., Seattle, Wash. The object of this invention is to provide a piston ring for a piston which is particularly adapted in preventing leakage of gas from the combustion chamber and which at the same time is provided with means for the oil admitted between the piston and the cylinder wall.

CHARGING DEVICE.—**J. J. CLARK**, 1624 Lake St., San Francisco, Calif. The invention relates to a pump having a piston and is designed as a convenient means for picking up a ball of loose material such as gravel or sand, lifting it to a desired height, carrying it to the paver or mixing machine and dumping it into the same. The object is to provide means which will allow trucks to dump the material at any convenient distance from the paver, from which the paver will pick it up and throw it into the paver when the machine is used.

Medical Device.—**W. H. HARR**, c/o H. H. Cotton Machine Co., Chicago, Ill. The invention has for its object the treatment of hemorrhoids by a new method, whereby a plug or tampon is inserted into the rectum, and the tampon is held in place by a band, and having a base for placing the rectum, and in connection therewith a means for the insertion of the tampon into the cavity to insure the thorough application of the tampon.

Medical Device.—**W. H. HARR**, c/o H. H. Cotton Machine Co., Chicago, Ill. The invention has for its object the treatment of hemorrhoids by a new method, whereby a plug or tampon is inserted into the rectum, and the tampon is held in place by a band, and having a base for placing the rectum, and in connection therewith a means for the insertion of the tampon into the cavity to insure the thorough application of the tampon.

MUTUAL INSTRUMENT.—**W. H. HARR**, c/o H. H. Cotton Machine Co., Chicago, Ill. The invention relates more particularly to a means for measuring the amount of material which is used in the manufacture of various articles, and has for an object to provide a device which is of simple construction, and which may be used in connection with a machine for measuring the amount of material which is used in the manufacture of various articles.

FLUTE OR SIMILAR MUSICAL INSTRUMENT.—**W. H. HARR**, c/o H. H. Cotton Machine Co., Chicago, Ill. The invention relates to a means for measuring the amount of material which is used in the manufacture of various articles, and has for an object to provide a device which is of simple construction, and which may be used in connection with a machine for measuring the amount of material which is used in the manufacture of various articles.

WOOD VARNISH INSTRUMENT.—**W. H. HARR**, c/o H. H. Cotton Machine Co., Chicago, Ill. The invention relates to a means for measuring the amount of material which is used in the manufacture of various articles, and has for an object to provide a device which is of simple construction, and which may be used in connection with a machine for measuring the amount of material which is used in the manufacture of various articles.

DEVICE FOR ADJUSTING VIOLIN BOW.—**W. H. HARR**, c/o H. H. Cotton Machine Co., Chicago, Ill. The invention relates to a means for measuring the amount of material which is used in the manufacture of various articles, and has for an object to provide a device which is of simple construction, and which may be used in connection with a machine for measuring the amount of material which is used in the manufacture of various articles.

REDUCTION BAR.—**W. H. HARR**, c/o H. H. Cotton Machine Co., Chicago, Ill. The invention relates to a means for measuring the amount of material which is used in the manufacture of various articles, and has for an object to provide a device which is of simple construction, and which may be used in connection with a machine for measuring the amount of material which is used in the manufacture of various articles.

ject and others are attained by a reduced set of magnetic rollers adapted to exert a reducing influence on the flywheel of the engine.

VALVE REGULATOR.—**R. G. HALL**, 1005 Henry Blvd., Atlanta, Ga. The invention relates to a valve regulator for internal combustion engines by means of which a valve is opened and closed in a predetermined manner, and is adapted to be used in all cases, which will serve to insure a minute and accurate opening of the valve, and the valve will be opened in a predetermined manner, and the valve will be opened in a predetermined manner, and the valve will be opened in a predetermined manner.

INTERNAL VALVE FOR INTERNAL COMBUSTION ENGINE.—**A. R. CLARK**, Box 4, New Haven, Conn. The object of this invention is to provide a valve for internal combustion engines, which will be opened and closed in a predetermined manner, and the valve will be opened in a predetermined manner, and the valve will be opened in a predetermined manner.

ENGINE CYLINDER AND HEAD.—**W. H. HARR**, c/o H. H. Cotton Machine Co., Chicago, Ill. The invention relates to a means for measuring the amount of material which is used in the manufacture of various articles, and has for an object to provide a device which is of simple construction, and which may be used in connection with a machine for measuring the amount of material which is used in the manufacture of various articles.

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parallel relation and for securely holding the rails to gauge and against spreading. A further object is to provide a device which will serve to insure a minute and accurate opening of the valve, and the valve will be opened in a predetermined manner.

AUXILIARY TRAIN CONTROLLING MEANS.—**J. J. CLARK**, 1624 Lake St., San Francisco, Calif. The invention relates to a means for measuring the amount of material which is used in the manufacture of various articles, and has for an object to provide a device which is of simple construction, and which may be used in connection with a machine for measuring the amount of material which is used in the manufacture of various articles.

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Our Readers' Point of View

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld where so desired.

A Suggestion in Automobile Design

To the Editor of the SCIENTIFIC AMERICAN

There is a point in the construction of most makes of automobiles which may be the source of very serious accidents. This point is the front tip of the front spring hanger.

As in this front tip of the front spring hanger, as occasionally occurs, the top spring leaf breaks down to the tip, the under leaves slide forward as much or two throwing the car body out of balance on the road and the rider jolting the steering gear. Then the car of course leaves the road, to be more or less smashed, according to the rate of speed and the condition of the roadside.

The broken spring tip, when noticed, is changed up to the effect of the crash instead of its cause, and the newspapers call it a mystery that the driver lost control of the car.

The front spring tips get a great deal of strain, where there is only the dampness of the top leaf and are not to break sometimes. The writer had this happen when he was going slowly enough to stop within thirty feet after leaving the road so that he was not wrecked.

Should not these front hanger tips overhang so that the lower leaves would not slide forward and jam the steering gear?

P. F. GARWOOD.

Mendon, Conn.

Resuscitation: Fact vs. Propaganda

To the Editor of the SCIENTIFIC AMERICAN

May we have space in which to comment upon the article appearing in one of your issues some time ago, "Making Use of the Life Belt?" We assume your correspondent, in preparing this article, abstracted a leading article in the current issue of the "American Gas Association Monthly Bulletin" in which the resuscitation apparatus described in three years.

As to Dr. Henderson's report itself, we are taking such scope as we feel proper to assure a continuation of the successful use of the pulmotor—the same resuscitation apparatus, as you will recall, which was widely honored by your organization in 1912 in the award to it of the SCIENTIFIC AMERICAN award for the best resuscitation apparatus described in three years.

As regards your correspondent's statement of Dr. Henderson's report, there are two statements which are distinctly contrary to fact and for which even an authority can be shown in Dr. Henderson's report. It should also be noted that these statements are decidedly detrimental to the pulmotor and contrary to the ideas of the officials of the Consolidated Gas Company of New York, who are still dependent upon their pulmotors for resuscitation work.

The quotations referred to follow:

"An investigation has shown that the usual method of using a pulmotor is far from satisfactory. It is an awkward, cumbersome actual injury done by inexperienced handling of the apparatus and the result, at best, are uncertain."

"The use of this apparatus is not so great as an advance over other methods that a number of recent accidents sustained by the gas company are now working in New York City with remarkable success."

Regarding the first of these statements the Consolidated Gas Company of New York City has pulmotors in an interrupted service since 1912. The pulmotors are still being used. We are not aware of any accident in an average of more than our order every two weeks for maintenance of pulmotors for the Consolidated Gas Company, indicating that they are often considerable in number. As an indication of the service being rendered by the pulmotors of the gas company, we would like to quote as follows from the August number of the "Mutual Life Bulletin," which is published by the Consolidated Gas Company:

"On Thursday, July 6, 1922, at 11:29 A. M., the Consolidated Gas Company's emergency dispatchers received a report from the police department to send all available pulmotors to a fire which had occurred in a tenement on the lower level of the Lexington Avenue Subway at Fifty-sixth Street."

"Four pulmotors were immediately sent to the scene and upon arrival found a scene of men and women partially asphyxiated from poisonous gas, with other illuminating gas."

"Messrs. DeGravel, Wheeler, Hale and Deane of the Twenty-sixth Street and Sixty-sixth Street emergency stations, rendered very heroic work in retiring a number of the victims, and were very successful in saving the lives of many."

"In a statement signed by Dr. Archer he stated that 'It was the Consolidated Gas Company's pulmotors which probably saved the lives of several.'"

"In the case of Harry Woodcock of 115 East 103rd Street, one of the victims, it is stated that he was for 40 minutes, Dr. Archer stating on the company's pulmotor resuscitated him, 'pulmotor saved this man's life. He

was very near death and we called a priest. Sent to the Reception Hospital after we had restored him to consciousness.'"

Please note that the date of this incident was July 6, 1922, and that it took place in the city of New York, as you through the Consolidated Gas Company. That that organization thought so highly of those inhalators as would be indicated by your article. It is not reasonable to suppose that they would have been put into service on the occasion instead of the pulmotor.

May we also briefly summarize from an article appearing in the house organ of the Consolidated Gas Company known as "Gas Logic," issue of April, 1922, as follows: "This year marks the tenth anniversary of the Consolidated Gas Company's introduction of the pulmotor for practical use in this city. Its adoption considerably later by private institutions and by several of the city departments has made it as familiar as a means for the resuscitation of persons who have been overcome by poisonous fumes of all kinds and in cases of 'hush death' that the casual use of a pulmotor and its frequent mention in the news columns of newspapers elicits little, if any, attention."

"These requests for the use of the Gas Company's pulmotors are not by any means confined to cases of persons overcome by artificial or flammable gas. In many instances the pulmotors are used for the resuscitation of adults or children who through accident have narrowly escaped drowning. In many other cases persons have been overcome by smoke or the fumes of chemicals that have been formed or liberated by fire. A man and his wife, both about 77 years of age, were both revived after pulmotors had been used about an hour upon them. The number of calls for pulmotors during the year 1921, 1922, not used in 1924, were 1,050, successfully used in 1,112, unsuccessfully used in 446 instances."

With the above facts before you, we have any possible way of justifying the statement that the usual method of using a pulmotor is far from satisfactory. It is not so. Incidentally, may we call to your attention that "Pulmotor" is a registered trade name protected by U. S. copyright, and the initial use of the word, therefore, be capitalized. "This is not to be construed as a criticism of your correspondent, however, as Dr. Henderson made such improper use of the word in his report."

As to the statement that "in some cases actual injury is done by inexperienced handling of the apparatus," you will surely appreciate that such a defamatory assertion regarding any apparatus and particularly as applying to a life-saving device with such a remarkable record and reputation as the pulmotor cannot and must not be made without the slightest indication of harmful results from pulmotor operation.

In regard to the last of the objectionable statements viz. "The use of this apparatus (Dr. Henderson's specially fitted inhalator, known as the 'Life Belt' or 'Hush Belt') has proved so great an advance over other methods of resuscitation that a number of recent accidents sustained by the gas company are now working in New York City with remarkable success," this statement is entirely contrary to the facts.

The use of II Inhalators is highly recommended by Dr. Henderson, more so than the use of the pulmotor, by courtesy of the Consolidated Gas Company. The Gas Company has been established by the local gas company and used by the Gas Company in any case of respiratory failure but only after spontaneous breathing had been established by the pulmotor, which was always accomplished by the II Inhalator on such emergency cases as carried the Consolidated Gas Company's Gas Company has indicated definitely that the II Inhalators are not now in use and that the pulmotors are used exclusively as they have been for ten years.

Many experienced physicians who have developed a great respect for the industrial work have taken issue with Dr. Henderson, who is openly countering his patent holders' claims as to the superiority of his inhalator to the II Inhalator at all resuscitation work.

In this connection, I beg to quote as follows from a recent report issued by the Carnegie Steel Company. In making reference to Dr. Henderson's recommendations to use the carbon dioxide gas in cases of asphyxiation during the resuscitation process, the report reads:

"However, it must be remembered that these experiments were performed on cases where the saturation of the blood with the CO₂ was not over 40 or 50 per cent, and while there is no doubt about the CO₂ increasing the depth and number of respirations, yet it must be remembered that the effect of the CO₂ is to increase the rate of breathing so much greater and that the heart is greatly weakened, so that with this sudden excessive stimulus it may fall. It would not, therefore, be recommended as a means of treatment,

except in expert hands, nor do I believe that in its present state of development it should be used in severe cases of gas poisoning."

During the last few years, quite a controversy has arisen over the relative merits of the II Inhalator and the classical means of artificial respiration, but both have their advantages and disadvantages. I prefer the mechanical method, using the pulmotor, for the reason that, in 100 very severe cases, this apparatus was used and excellent results obtained, with no noticeable after-effects."

In view of the facts presented above, which may be confirmed in any manner desired by your correspondents, we are sure that Dr. Henderson since the doctor has simply shown that he is not a differentiated party on the subject of resuscitation—we feel very strongly that a statement should be made in the next issue of the SCIENTIFIC AMERICAN pointing out that the pulmotor is being used successfully, that the statement that actual injury is caused in some cases by its use is not borne out by experience and that the Consolidated Gas Company of New York is continuing to use the pulmotor exclusively with the very best of success. We do not request this in such language as we are manufacturers of the pulmotor, but more especially because it is of vital importance that the remarkable life-saving apparatus possible for the conservation of human life in general. Realizing as we do that your editorial staff desire nothing but the best, we are sure that you will make available advertisements in this matter.

AMERICAN ATMOS CORP., LTD.

NEW YORK.

Container Cars Fifty Years Ago

To the Editor of the SCIENTIFIC AMERICAN

In a recent number your description of the Container System of transporting goods, which was published, led me to mind that the same system was in use half a century ago in the Port of New York and Boston. Your illustration shows four containers stacked one on top of another, and the four Liners line up in a row, each carrying a full length train, the morning the "steam boat train" tried to pass a freight train standing on the main line at Manhattan, with the usual results, the containers were broken up and the contents scattered over the landscape.

C. H. FARMAN

University City, Washington, D. C.

Solving the Water Supply Problem at Panama

To the Editor of the SCIENTIFIC AMERICAN

Furnishing fresh water 770 cubic feet per second 80 feet high at 11.25 cents efficiency of plant will require 10,000 kilowatts and require lower. An engine would have to use 11.25 cents efficiency, not more than one-half as much boiler horsepower. Compare such a plant with any of the great power plants in New York and other large cities and it will be seen that the Panama plant is a very different animal. The cheapest fuel would be coal, but it would be used in such a way that the cost would be reduced to one-third of the cost of the coal used in the Panama plant. The cost of the plant would be \$1,000,000, with a power plant running continuously, requiring 10,000 pounds of water per second at 11.25 cents per kilowatt, would be \$1,000,000 per second. Assume that coal delivered to the canal by water at 11.25 cents per ton, the annual cost would be \$1,000,000.

A pumping plant for this purpose, using direct connected steam pumping units, should not cost more than \$100 per indicated horsepower, or \$1,000,000 total investment.

To meet the water demand of the Panama Canal for pumping in all the water used as for the year 1920 would be 10,000,000,000 cubic feet.

Cost per second interest and depreciation 100,000
Operation 12,500

\$100,000

But the total water for power and lockage in 1920 must have been nearly 2,000 cubic feet per second, all of the shipping should increase to the equivalent of the Panama Canal, should not cost more than 100 cubic feet per second. If the Panama Canal furnished 2,000 cubic feet per second in 1920, it may be assumed that the Panama Canal would have 8,000 cubic feet per second for

which power would be required, or 4 times the amount as calculated for the locking of the Panama Canal, or \$2,000,000 per year. The revenue from the canal for one year is \$1,000,000, the revenue from the Panama Canal for one year is \$400,000,000 at the cost for pumping would be approximately 8 1/2 per cent of the revenue.

PANAMA.



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Science Notes

Big Yale Telescope for South Africa?—It is possible that a powerful telescope will be placed somewhere in South Africa to view some stars which cannot be well studied from the northern hemisphere.

The British Museum Has No Place for Films.—Although the British Museum has over fifty miles of shelving for books they have no space for the safeguarding of historic films like those of the funeral of Queen Victoria. The War Office has preserved films of the British Army during the war.

The Metric System.—The metric system is proceeding slowly as regards its adoption in English-speaking countries. One suggestion which was made at a housewives' given in New York on May 6 by the Metric Association was that the content of later national trade is at present hampered and confused by the circumstance that the content of the British gallon is greater than that of the American gallon. The recommendation was made that both governments should abandon their standards and adopt in their place the liter as the common unit of capacity.

Curious London Trades.—The London Blue Book is a voluminous tome, but contains some curious information. London was a solitary habitation, who live in a suburb at Wandsworth. It has one woman blacksmith, who works in Battersea, and there is one woman bricklayer, who resides at Leyland. There are two London women who are gardeners' laborers. While the county of London has but one falconer, the city of London (proper) has but one fisherman. Among the queer trades are "housekeepers," "housekeepers," "scrub brushers," "tracers," "slabbers," "scrub brushers."

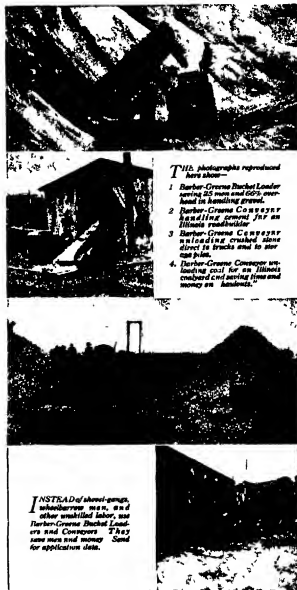
Petroleum Among the Ancients.—The oil industry had its birth in the United States about 1800. It was first discovered in an oil well drilled at Titusville, Pa. But our Indians, and the races before them, knew crude oil. Thousands of years before Christ, Babylonian and Chaldean men used it in a liquid form for cementing the bricks of their towering walls, and it was used in building the Pyramids. Herodotus mentions a well from which three substances, asphalt, salt and oil, were pumped. Oil from natural springs in Sicily was used in lamps in the temple of Asclepius at Epizephi, and the wealthy illuminated their houses with it. The ancient Chinese and the Persians used it for light and heat, and it enters into the prescriptions of the Egyptian embalmers.

Cultivating Perfumes.—A process, the invention of M. Daniel, professor of botany at Rennes, by which the perfume of flowers is greatly increased has been explained before the Académie des Sciences in Paris. By taking two plants of the same species and grafting one on the other—usually a worm wood on a chrysanthemum—he found that only that the grafted wood developed remarkably, but its flowers gave forth a perfume much more powerful than that of the original plant. Moreover, the chrysanthemum laid given to the wormwood flower something of its own perfume. The professor collected several such grafted plants and found that the following year obtained from them in some plants. They had this peculiar feature—that while the flowers of some of the plants emitted a perfume similar to those of the original graft, others were absolutely without odor.

A Gas Celebration.—The Consolidated Gas Company of New York City recently celebrated their centenary. The first plant of the company was built at 100th Street and Broadway (now Center Street), and one mile of three inch main gas line was laid to the city. The first gas street lamp lit was at 11th Street and Broadway, and a crowd viewing it in respectable numbers because of the fuelled danger of an explosion witnessed the ceremony.

The house of Hummel, Leggett, president of the company, at 7 Cherry Street, was the first home in New York City to have gas illumination. The first gas container of the old company had 15,000 cubic feet of gas and the superintendent was criticized for extravagance for seeing one of such large capacity. Today in Astoria, La., the Consolidated Gas Company has a series of gas holders, two of which, the largest in the world, have a capacity of 15,000,000 cubic feet each. In 1828 the cost of gas to the consumer was \$10 a thousand cubic feet. It had fallen to \$7 by 1864, but jumped back to \$6 40 later because of the increased cost of materials.

Common labor is getting to be very uncommon



- This photograph reproduced here shows:*
- 1 Barber-Greene Bucket Loader saving 25 tons and doing over 1000 handling yards.
 - 2 Barber-Greene Conveyor handling cement, just as it comes from the mill.
 - 3 Barber-Greene Conveyor handling cement from the mill to the storage bins.
 - 4 Barber-Greene Conveyor saving 100 tons and doing over 1000 handling yards.

INSTALLED sheet piling, substructure work, and other essential labor, use Barber-Greene Bucket Loaders and Conveyors. They save men and money. Send for application data.

BECAUSE of the general scarcity of labor and the stoppage of some sources of supply, wages are advancing rapidly. Industries with year-round requirements for common labor are especially handicapped because they cannot compete successfully with the appeals made by the construction industry. One effect of the scarcity of common labor is the installation of more and more labor saving machinery—especially of material handling equipment. The sales of Barber-Greene Bucket Loaders and Portable Conveyors are greater than they have ever been for a similar period—greater even than in 1920. Much of this increase is due to general conditions, but even more is due to the superior advantages that this equipment has to offer. Most important is its adaptability to many and changing conditions. The Barber-Greene Conveyors, for instance, can be extended to any length up to sixty feet by the addition of standard three-foot sections. The Barber-Greene Bucket Loaders (mechanical shovelers) have an automatic feed that operates so efficiently that it eliminates the need for hand-shovel chafers. Send for our catalog A-B and additional application data.

BARBER-GREENE COMPANY, Representatives in 25 Cities Western Park Ave., Aurora, Ill.

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Science Notes

Forty Million Marks for a Elephant and a Hippopotamus.—Lamover has been obliged to sell part of the *Elephant*. A French animal dealer paid 40,000,000 marks for the two animals named above.

New France Set for Daylight Saving.—Summer time received a set-back when the French Cabinet decided not to interfere with Standard time, but that everything should start half an hour earlier. Noon trains were at 11.50, the theater runs half an hour earlier at 8.30, and so on.

Specialist Sunday Schools Attacked.—Baptist Sunday Schools are making a certain amount of progress in England, about 12,000 attend such services. Efforts are being made to influence some of them to become Methodist. This has resulted in powerful attacks backed by well known persons.

Greece Adopts the Gregorian Calendar.—Beginning with March the Gregorian calendar was adopted for civil purposes in Greece. At present has apparently adopted the same course for the old, or Julian style, has become practically obsolete. The Greek Church is not at present adopting the reform, the present being the expectation of the speedy adoption of other calendar changes in the west, for which it professes to wait.

Will Map Europe's Sky.—A plan to map the entire sky of Europe is being carried out under the direction of the National Weather Bureau, which already has mapped the sky of France. Weather observers and amateur photographers of the Continent will be asked to assist. The photographs will be used to make daily exposures over a period of a week or two. The photographs will be sent to the National Weather Bureau, where the census of the weather conditions at the time will be reviewed from them.

Hockey in Ancient Greece.—An ancient Greek sculptured relief recently discovered at Athens according to the London Times, gives evidence that the Greeks played ball games other than with the lance. The relief represents six naked youths taking part in a game bearing every resemblance to modern hockey. The curved stick used may possibly signify an explanation of the animal curved object carved in relief on some of the votive offerings found at Sparta. These have been called "dicks." It is difficult to say why this implement should have been dedicated to Athena, but the word "dicks" may have been the current slang for a boy's hockey stick.

Radio Messages in Thunderstorms.—The Weather Bureau, although without facilities of its own for conducting investigations in this field, has cooperated in various ways with other agencies also interested in conditions affecting wireless telegraphy. As a result of work done by Nebraska Wesleyan University based on thunderstorm reports furnished by the Weather Bureau the investigators reached the conclusion that there is no relation between barometric pressure and audibility, and that conditions at the sending station do not influence the audibility at a distant receiving station. High static frequency, high static audibility and a nearby thunderstorm area, however, tend to reduce the audibility at the receiving station.

Jungle Instincts of Caged Animals.—Wild animals in captivity live at night an imaginative life entirely different from their dull hours when the sunburns face is in front of their cages, according to Dr. R. T. Pook, superintendent of the Zoological Gardens of London, who is about to retire after many years of service. At night, he says, the laborious life of the jungle shows themselves in striking fashion, and the beasts throw off the sleepy veneer of indifference they seem to adopt when humans stand in front of their enclosures and speculate upon what mischief living in the animals indirectly gives them liberty. "If you go into the lion house during the day you are nearly always impressed by the peaceful way in which the animals regard you. But visit them at the first darkness and instantly you are aware of the change. As if by magic their instincts in hunt and to kill have returned. Nothing is more vivid than to walk past the cage of a lion or a tiger and then turn around. To your astonishment you see that the animal has been staring you just as if he were still living in natural surroundings. The instant you turn your head he drops flat on the floor of the cage." Mr. Pook believes that wild animals never really grow tame and that man has domesticated every animal worth while.

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Electrical Notes

Electricization of the French Railways.—Inviting of five billion francs during a period of ten years, is the program of the French Government, which has approved the immediate expenditures of 80,000,000 francs in the Paris-Chart Orleans line and 124,000,000 francs on the Midi line.

Electric Heating for a "Shrink" Fit.—In order to fasten securely the shaft upon a 4000-kilowatt rolling motor into its large rotor casting, a "shrink fit" was decided upon. The necessary shrinkage was calculated to be from 0.5 millimeters to 0.6 millimeters, requiring the heating of the bulley rotating to about 200 degrees Centigrade to 250 degrees Centigrade. To accomplish this without undue loss of time and with great accuracy, electric heating was resorted to, using alternating current in a few turns of cable around the rotor hub as a short electrical secondary. A number of calibrated thermometers, placed at different points on the hub, measured the rising temperature during the process. The job was successfully finished in 16 hours, consuming 50 kilowatts, of which 34, kilowatts were the copper losses in the cable.

Permanent Magnet Steel.—Extensive research work carried on in the Physikalisch-Technische Reichsanstalt—the Bureau of Standards of Germany—with various steel alloys suitable for permanent magnets resulted in the discovery of an alloy steel with considerably improved magnetic properties. Based upon previous tests on iron-manganese steel with an addition of cobalt, the saturation of the steel has been increased beyond values previously known on chromium and tungsten steel, according to *Motor World*. A further improvement was achieved by adding 5 per cent of chromium resulting in a three times higher product of remanent force. The best results were obtained with an alloy containing 11 per cent carbon 3.5 per cent manganese 50 per cent cobalt, 4.6 per cent chromium and 54.6 per cent iron.

Electric Heating of Large Buildings in a subject discussed at length in a recent issue of *The Electrician*. The following interesting figures are cited in connection with the heating requirements and the electrical load necessary to fulfill them. In theaters, which are very economical places to heat, owing to the absence of outside windows 10 or 15 degrees' rise over the outside temperature is sufficient. Electrically this means 300 watts per 1000 cubic feet. In domestic work a useful semi "rule of thumb" method is to allow 60 watt per cubic foot for a 20 degree rise of temperature per hour, or 60 watt per cubic foot for a 20-degree rise. These figures preclude the use of central heating apparatus only. If ordinary fires, stoves or electric are used in addition the figures given above may be reduced 50 per cent. It may be mentioned that this data is based on the heating engineer's rule of 18 square feet of heating surface per 1000 cubic feet of space. It may be added that the success or failure of any particular installation largely depends on the positions where the apparatus is installed. In a room a position under the windows is the best place, but in large halls and churches, places in the roof or half way up the supporting columns may be used with advantage to counteract down-drafts and to obtain that even heating effect which is so desirable, and this effect is assisted by dividing the heating surface into small units. In this way, too, a great reduction in the electrical load required can also be effected, as witness a case at Billerhook wherein a normal heating load of 800 kilowatts was reduced by 45 kilowatts and space was saved by placing the heaters on the supporting columns. Various types of electric heaters may be employed, such as the straight electric heater with resistance wire for gas heating, but which is imported directly from the air, or in the form of radiant heat, is directed toward the portion of the premises to be heated, or combination electric-steam radiators, in which electric heaters produce steam in a small radiator unit. The electric system of heating has the great advantages of responsiveness and easy regulation. In an ordinary central heating system control is difficult and can only be effected from one point. In this system each radiator is complete in itself and can be turned on, off or down as required. In heating churches by ordinary hot water equipment it is necessary to fire up some 48 hours. With electric heating this preliminary period is reduced to four or five hours.

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Mechanical Engineering Notes

Magnetic Separation of Coal From Slag has largely replaced the older method of separation by varying specific gravity wherein water was used. By the dry magnetic system the varying magnetic properties of the ferric oxide resulting from combination of the iron pyrites and the combustible matter are used.

Brass Castings—Not many years ago the chemist was unknown in the brass foundry, the cutter playing "chemical" himself. The master cutters mixed their brass alloy with a great deal of mystery but very little exact knowledge. Nowadays the temper of the brass is tested by pyrometers, mercurous iodide and photo-micrographs, while hydrostatic and other tests expose its weakness.

Keeping Valves Clean—First put into practice by an automobilist to keep the carbon down, this device looks as though it might have a more general application. A simple lock washer was put on the valve stem, just below the valve, and as the valve moved up and down, this washer was brought into contact with the heating surfaces every time the valve rose. The result was a valve always free from carbon.

Centrifugally Cast Iron Pipe requires heat treatment because the molten iron, being thrown against a rapidly revolving wall, increased metal mold is more or less chilled and, when the pipes are removed from the machine, they are more or less hard and brittle. Pipe made in sand molds do not have to be heat treated. The furnace used is oil fired, its heat being controlled by a pyrometer.

Aluminum Solders cannot employ the ordinary soldering metals, excepting magnesium because they are electro-positive to aluminum and thus act electrolytically in the presence of moisture as positive galvanic poles, accelerating the corrosion of the aluminum. Magnesium alloys deteriorate rapidly in the presence of moisture. Therefore the soldered joints should be protected by paint or enamel. Zinc tin and silver aluminum solders give the best results.

Eye-sight in Factories is the subject of an article in the *American Machinist*, wherein it is stated that it is almost impossible to find a man with perfect eyesight after the age of 40. An examination of more than 10,000 employees in factories showed that 53 per cent had uncorrected faulty vision. Blue spectacles, on the average, occur more frequently in the dark winter months. Painting the factory walls white will not only reduce this trouble but will cut down the light bill.

Zirconium in Heat-Treated Steels—A writer in *The Iron Age* states that only very carbon steels in which a small percentage of zirconium has been incorporated may be made to possess by suitable heat treatment physical characteristics approaching those of the highest grade heat-treated alloy steels. Additional experimentation has demonstrated that the properties of a number of the well known alloy steels may be improved through the use of zirconium. Also that by aluminum treatment it is sometimes possible to use advantageously the ordinary alloying elements in less than normal proportions.

Corrosion Process—A writer in a recent issue of *General Electric Review* states that much may be learned in very short time about the corrosion resisting properties of steel by observing the action of a drop of water upon the polished surface of the metal. Drops of distilled water in equilibrium with the air of the laboratory were placed upon various steel surfaces. In the case of pure iron, corrosion began almost immediately, and at the end of a few minutes the corrosion product could be seen distributing itself, always according to the same pattern. Three distinct zones developed, an outer one, which has been called by us the "innocent" zone an inner one, which occupied a large part of the area of the drop, and a "well" zone, which lay between the outer and the inner zone. The outer zone was perhaps one-half mm. in width, and the well zone was best described as a line. The iron rust was evenly distributed over the level on the well zone and the outer or innocent zone was entirely free from deposits of any kind. The length of time elapsed before the first appearance of rust, and the amount of rust present after the drop had evaporated were greatly with different steels and form the criterion for judging the corrosion resistance of the particular steel under examination by the simple test.



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MMUSICAL comedies are a far cry from the Scientific American's daily tasks, yet it has come to our attention that the two have recently joined hands. A current musical play in New York depicts a writer famous for his articles on emeralite used in paints, and to cloak him with proper authority the playwright has him announced as a writer for the Scientific American. Here the name of Scientific American is used for authority's sake—recognition from the play-world that this name carries weight of recognized reputation.

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Our First Test Senses

(Continued from page 62)

desirable thing, regardless of whether he believed genuine or fraudulent, or whether no opinion at all be held as to his status.

The arrangement of all the chairs was necessarily fixed before the medium's arrival, he first saw the room after it had been completely dressed up in twine and wooden strips. He entered the room with a demand on his lip for a complete rearrangement of the position and orientation of the chairs, on the ground that the people currents would be hindered thereby. We pointed out how much work would have to be undone, and promised much a change, to be made to his dictation, the next time we sat. He let the matter drop there, which I thought indicated lack of confidence in the argument; he had been advancing.

We came near total disruption right at the start. Mr. Oswald Munn was in attendance, with a young lady friend. She had not been told just what might happen, and when, shortly after the darkness descended, the spirit selected her for the first touch, she gave forth a shriek that might have been heard blocks away. The medium was very much shaken up by this, but the young lady was quieted and the seance went on.

We had a sitting "chair" in phenomena that Monday's, but poorer than Tuesday's. Again the medium displayed too much knowledge of what was going on. The trumpet crashed to the floor between Houdini and Mr. Hopkins, and they were uncertain whether to recover it or to let it alone. Without their having given expression to this hesitation, the medium stated that they were excited and leaning over the trumpet to pick it up, and warned them not to do so. The accusation was in accord with the facts.

A talk hypothesis of fraud, little was done that would have led the medium out of his seat. When anything of this character did occur, however, the record showed, without exception, that he was out of it. In all he left it fifteen times, for periods as long as 15 seconds at a time. There can of course be no valid reason for this; and, since he was not in trance, not even a valid excuse. The parallelism between the absence of the medium from his chair, and the phenomena is displayed elsewhere. It should be emphasized that all his absences from the chair are listed in the table on page 14.

During the evening the medium discovered and questioned the softness of the floor under his chair. The stenographer missed this incident. It was apparently between 9:45 and 10 o'clock after the preliminary exploration of the circle with a trumpet from the medium's chair had been completed, and the phenomena involving his movement had begun, and after he stopped his free circulation at 9:45. If one might hazard a guess as to what happened, it would be based upon the fact that the medium's movements were on this evening suitable for the first time. This would argue that he is accustomed to shifting uneasily about a flat floor, but that one with a little fall under his chair would make him a trifle awkward, and would finally oblige itself upon his consciousness. After nine collisions and polings in nine minutes, he would have sensed the presence of the obstruction, and explored it thoroughly by hand, to assure himself that it was there. Then he would have slowed down materially the tempo of the seance, and as this slowing down had covered all the alters realized, even before the sitting broke up and we had time to cast an eye at the records in the next room.

For one more incident of this final seance I must find space. It involves lifting a column of advertising to make room for it! On Tuesday a whispering voice had presented itself to me, quite close, attempting to articulate a word or two of syllables. I and my neighbors at first judged this to be a name. We all strained our ears to catch it, and it was repeated twenty times at least. I encouraged this to go on until I had fully satisfied myself that it was in fact wholly intelligible, and that anything which it might be understood to have said would have been wholly due to the listener's imagination. Then I encouraged it to stop, and it stopped. One of the known tricks of questionable mediums is to give much inarticulate sounds, hoping that the sitter will identify them through such active imagination and active desire for the presence of some dead friend as he may have. When it works, it usually "goes big," the sitter feels out all sorts of information about the departed one, and promptly gets it back from the voices. I determined to learn, if this whisper was re-



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pointed on Thursday, whether it would do this.

That the spirits had played me out of the crowd was plain from the beginning of Thursday's sitting. I got ten touches to every one by anybody else. Plainly, sure enough, the same losses which came to me, on Tuesday, suggested that it was trying to pronounce my name. Over the latter (it had adopted this suggestion and made it its own for now I said, "Hello, Mainline," as plainly as human being could possibly whisper these words. The fellow in charge is not necessarily an exact transcriber of what I said, but it is sufficiently so to stand on a faithful account of the incident, in spirit if not in every letter.

But, yes, this is Mainline. Who are you?

Voices: Waves (I adopt this purely arbitrary symbol for a whispered murmur that was absolutely without articulate form)

I don't quite get it, try again.

Voices: Wa wa wa

Voices: Wa wa wa

But (stalling desperately while trying to think of a name different from that of any deceased relative or friend) Did you say Harry?

Voices (portally and with absolute clarity): Yes, Harry.

But: Oh, Harry you said is that you Harry?

Voices: Yes, it is Harry. But (after giving it time to see we mean what it would do) Well, Harry that's fine. But Harry, suppose you try to give me your last name. It would be quite awkward if you could do this.

Voices: Wa wa wa

It had been several seconds and I had encouraged it each time, I finally was able to get out of my mind a name I was certain meant nothing to me. My eye I supposed it as I had supposed the Harry and the voices immediately became articulate long enough to say: Yes, Myer. Harry, Myer. "Then it began into wa wa wa."

I was extremely interested to learn how long I could keep this haunting up, and how long Harry would keep it up. So while I was intending a collusion between an auto mobile and a telephone pole which might reasonably stand as the agency of Harry's desires, I got off some snappy matter as the following punctured by Harry's faithful wa wa at appropriate intervals.

Suppose you speak to me, Harry, see whether you can tell me something of the circumstances under which you died."

Here Harry recovered from the wa wa sufficiently to articulate clearly that he never had died. I explained to the company that I had inadvertently used the wrong word, that Harry's expression for what had happened to him would be "passed on." I substantiated this and named the family and Harry lost his command of English and repeated the wa wa a longer space. But I stuck to the subject.

"Now, Harry, can't you give me something about the manner in which you passed away? Perhaps you can indicate whether you died a violent death? Did you pass over by violence, Harry? Did you (have I made what I hope would stand for a painful effort to select words that should not reveal too much) pass on suddenly? Was it—was it an accident?"

At this stage Harry was convinced that it must have been an accident, and he repeated his speech long enough to say: "Yes," most emphatically. But my construction of a personal identity for him was rapidly later ruptured. My colleagues, Messers. Walker, Lowenbours and Mims had been struggling with their difficulties for some time. Mr. Mims' sense of the humor of the situation got away from him and to my horror I heard a loud snicker from his direction. The question set off the two gentlemen at my right, who burst into outright laughter.

I was afraid that everything was off, but I tried to save something from the wreck by saying, in an unconvincing manner: "Gentlemen there is nothing to laugh at." This was effective in silence, then, but unfortunately for the continuation of my demonstration with Harry Myer, Mr. Smith took the cue from me and proceeded to read them a lecture which was even funnier than my efforts to bring artificial speech out of Harry. He indowed my remarks thoroughly and enthusiastically, striving with great severity that this was a mighty solemn occasion, and that it was painful indeed to have it marred by mockery. That it was a very serious and solemn and sacred business being thus led into the presence of the dead, and

(Continued on page 69)

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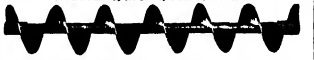
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Radio as the Fisherman.—Herring fishermen of the Swedish coast are being bested on the location of schools of fish by radio telephone. These lines on the shore shoots of the herring have resulted in an increase of efficiency on the part of the fishing crews. On an average they return with a boat filled with fish more often than they have done before the installation of radio. Naturally, it will be recalled, was the first country to make extensive use of radio in connection with fishing operations. However, the German application of radio was limited to radio telephony, and called for a knowledge of the telegraphic code on the part of the fishermen making use of the service.

Wireless Telegraphy and Telegraphy Compared.—This is an abstract of a report of a sub-committee of the Radio Research Board of the Department of Scientific and Industrial Research. The possibility of establishing satisfactory radio telephone communication on a commercial basis for a distance of 300 miles or more is considered to be remote. The power for radio telephone services is estimated to be from 2 to 20 times greater than that at present considered necessary for similar radio telegraph services for the same range. Sea medium ranges say 1000 miles, the difficulty as regards a commercial service are practically the same as those for long distances. The position as regards short-distance communication (200 miles or under) is considered to be more hopeful. The conditions most suitable for a commercial service are enumerated and the extent to which these can be met is stated.

The Speaking Flame.—It begins to appear as though the carbon microphone which has long been employed for the conversion of sound waves into electrical variations in wire telephony and radio telephony, is doomed to extinction—at least as far as the radio end of its application is concerned. For wire telephony it must outlive its usefulness; it is simple and fairly efficient, but for the transmission of radio programs the usual carbon microphone is by no means satisfactory. We have already noted the Photo-photo-phone transmitter used in the WGY broadcasting station of the General Electric Company, and the glow transmitter in the KIVA Westinghouse station. Now we have to report the DeForest speaking flame transmitter, which is a development of the DeForest's phonograph or talking picture. "Take the ordinary best wiring gun burner or a certain form of Wobach's musical gas light, or special forms of oxy acetylene gas flames, insert two best twisting electrodes thereto, in proper relation to the flame and to each other, connect these electrodes to an appropriate electro-motive force, and you will then have an extremely small size sound converter which gives an electric reproduction of the sound wave in the air surrounding the flame which is of an entirely different order of fidelity from that ever obtained from any form of microphone device, using a diaphragm, whether this be of the carbon, electro-magnetic, or electro-static variety." states Dr. DeForest. "In my phonograph work we have found in the same way that when a series of very fine and very sharp platinum wires are heated to a dull red from a local source of current, the resistance of these wires changes alternately increasing and decreasing in conformity with the sound waves impinging thereon, so that from a telephone transmitter connected in series with a battery of this thermo-microphone, a remarkably faithful reproduction of the sound waves impinging thereon can be obtained, even though the frequency of these be as high as 3000 per second. The sensitiveness of this device is further enhanced through a gentle stream of air, by fluid evaporation in the neighborhood, or by other auxiliary means. Of all the diaphragm types of transmitters, unquestionably the electrostatic type as perfected by engineers of the Western Electric Company, comes nearest to approaching perfection. While this is extremely insensitive compared with the best carbon microphone types, there is no comparison between the fidelity of reproduction by the two means. But one listening in a telephone to the reproduction by means of the flame microphone, and then by means of the electrostatic microphone, will at once realize that the fidelity of reproductions in the first case is of quite a different order from that obtained even from the highly perfected diaphragm of the best electro-static microphone."

Kellogg Radio Equipment for Better Results



No. 6-A VARIABLE INDUCER (250 CHMS)

KELLOGG SWITCHBOARD & SUPPLY CO., CHICAGO

Kellogg apparatus exclusively in use in building the Symphony Receiver

Handreds of testimonial letters tell us of the superiority of our head sets in actual comparative tests, barring none.

Increased volume, unusual clarity, long distance receiving, are some of the reasons for the rapid growing popularity of Kellogg head sets.

Your receiving set is not complete without a Kellogg No. 6-A head set. A few minutes listening will convince you of its merits.

Have you seen a Kellogg variable condenser? Let no one detain you until you have. It is a test condenser in every sense of the word. Takes the uncertainty out of tuning.

Note the size and construction of the plates, the method of mounting, the bakelite ends. All have a direct bearing on your satisfaction with radio.

Improve the reception and tuning of your set with a Kellogg variable condenser.

Kellogg radio parts are of the highest grade throughout and the workmanship is of the best, giving radio fans a product that produces definite results.

The best is the cheapest in the long run. Why experiment?

Built and guaranteed by

One of the World's Largest Manufacturers with unlimited resources Builds Cunningham Tubes

FORTY-THREE years ago the carbon filament electric lamp, at that time considered the finest development in electrical art, came into general use.

The important and ever-growing demand applied in the building and expansion of electric factories and the improvement of electric lighting, led to the development of the carbon filament electric lamp, which is the basis of the modern electric lamp.

In recent years these same highly skilled manufacturers have been able to produce a new and improved carbon filament electric lamp, which is the basis of the modern electric lamp.

The new Cunningham type C-1-A Amplifier and Detector vacuum tube, and the perfecting ability combined by the art of the electrical engineer, the result of many years of experience, has produced a new and improved carbon filament electric lamp, which is the basis of the modern electric lamp.

The low filament current of only one-fourth of an ampere and the fact that the filament is not subject to the same wear and tear as the filament in the ordinary carbon filament electric lamp, are the two main features of the new Cunningham type C-1-A Amplifier and Detector vacuum tube.

C. Cunningham Inc.

1000 Fifth Avenue
New York City

Eastern Representatives:
Chicago, Ill.

A Specially Designed Tube For Every Radio Use

PATENT NOTICE
This notice is hereby given that the patent for the new and improved carbon filament electric lamp, which is the basis of the modern electric lamp, has been granted to the inventor, C. Cunningham Inc., New York City, and that the same is now in force and effect.

Deaf Can Hear Says Science

New Invention Aids Thousands

Here's good news for all who suffer from deafness. The Deograph Products Corporation announces the perfection of a remarkable device which has enabled thousands of deaf persons to hear as well as ever. The makers of this wonderful device say it is too much to expect you to believe this as they are going to give you a chance to try it at home. They offer to send to you by prepaid parcel post on a money order trial. They do not send it C. O. D.—they require no deposit—there is no obligation.

They send it entirely at their own expense and risk. They are making this extraordinary offer well knowing that the scope of this instrument will be so great and definite that the majority of those who bring in orders are very glad. Thousands have already received their sets and they are now using them. There is no doubt that you should receive the mental and spiritual satisfaction which comes from hearing. You will not only hear but you will also know that feeling of well-being from which all deaf persons have been cut out since your eyes in the world and because you will see your future outside your ears. You will hear and see and know that the Deograph Products Corporation, 100 Center Building, New York, Inc. deprecates criticism and request checks.

Oil for Fuel Writes Dividend Checks

The savings of fuel oil over coal for the industrial power or supply plant are enormous. Fuel oil is cheap and plentiful. There is no danger of shortage, with its resultant expensive consequences.

Business Oil Engineers furnish plans and specifications for the installation of oil engines. You do not pay for waste power. Oil Engines will offer large savings in every class of power production. In fact, we find in lost time. Businessmen are waiting to increase their dividend checks.

Write for descriptive literature and see how your power is being wasted. One of our engineers will be glad to advise you. Our literature is sent by mail.

THE BESSEMER GAS ENGINE CO.
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AMERICAN OPEN HEARTH STEEL
American Bessemer Steel
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KEYSTONE
COPPER STEEL SHEETS

Black and Galvanized

Extensive Open Hearth Steel is also made by the addition of a certain percentage of copper to the steel. This copper steel is used for the manufacture of all kinds of machinery and structural work. It is stronger than ordinary steel and is more resistant to corrosion. It is also more ductile and can be worked into many shapes. It is used for the manufacture of bridges, buildings, and other large structures. It is also used for the manufacture of machinery and other small structures. It is a very versatile material and is used in many different ways.

Our First Test Seances

(Continued from page 62)

that he was very sure that if any of these questions were to think that his dear as perished mother had come to him and he had not her with a cover, he would regret it for the rest of his life. That he and the medium had come here to put this thing over, this great medium. That they weren't here for the money prize—that if the medium wanted only money, he (Mr. Blatty) had more than \$5000 in his pocket that he could hand right over to him. They had come here to put this thing over, so that we might all know about it, without any doubt or suspicion of fraud. I had been to 5 or 6 that he would not finish at all, but he did it in a real happy and receptive frame of mind for the phenomena. That Harry was gone, and wouldn't come back.

Well there we are. I don't suppose it is necessary to state specifically that the name Harry Meyer means absolutely nothing to me or to faintly recall that while the "spirit" which claimed that name was absolutely unable to make an articulate sound save in repeating what I had put into its mouth, in doing this it could talk as plainly as I can.

Through a premature statement by a member of our committee the medium learned from the daily papers that he had been observed to be frequently out of his chair, but he did not learn the observed coincidence of these absences with the major phenomena of the seance. He called upon us immediately for the purpose of "explaining" the record. The substance of this explanation was that at times during his seance he is lifted from his seat by the spirit forces. In support of this claim, he reminded us that he had made it twice during the seance. The fact is, however, that on neither of the occasions when he advanced the claim that he was being lifted did the light record his absence from the chair, while both claims came after he had discovered the curious nature of the footing under the chair.

I view this, of all the facts which I have put down, as the one upon which there have been accused, not by the mediums, but by the sub-Committee considering Mr. X's mediumship, that it is possible to make a definite report on the basis of these three absences. The sub-Committee consists of Drs. Peirce and Carrington, and Howland. It finds that the medium has failed to give any evidence whatever that the mediumship is genuine. It therefore rejects (see the statement of the conditions of our offer in our January Number) that the medium has failed to qualify for further investigation by the sub-Committee or the full Committee—that his mediumship stands rejected and that his claim to the prize and to the Committee's further attention stands vacated.

Trapping the Burglar

(Continued from page 7)

burglar was not apprehended. A good many innocent tramps and other young men suffered full terms to be sure, but the authentic rubber was rare.

One of the worst offenders by the millions of the unrepentant criminals was the owner of the local mill. He had been burglarized at least a dozen times. Finally, without consulting anyone, he rigged a trap in his place and waited. At the end of the first week the miller found that his gun had been discharged and discovered traces of blood inside and outside the premises. A thin trickle of red was followed by the police and led to the home of Charles Adams, the town's first citizen. After a dramatic trial Adams was sent to prison and later escaped. It is said, by inducing hypnotic sleep and being carried out of his room in a coffin.

Similar ironic comedies have followed the employment of the set gun in other communities. But pathetic or even tragic results have been the usual number of such drastic remedies, with the result that laws have been passed ordaining this kind of thing in various localities.

The late war, with its vast employment of poison gas, has had a very definite part upon the development of explosive their catches and broader alarms. In New York City alone there are today a dozen makers of various kinds of snuffing devices, known along as the nocturnal prowler. I remember with considerable nervousness my first contact with one of these mechanicians and its inventor. He had followed me to a nearby summer resort for the purpose of demonstrating his goods and finally overtook me in the lobby of a certain fashionable where he backed me into a corner and breathless

The Sign of Achievement

Indian Traditions

According to tradition the circle just above had touching the arrow head of the dying Creek Indian indicates that he had actually obtained perfection in battle persona.

Ludlum Accuracies

Just such a sign of perfection is the trademark of Ludlum on his steel, metal the world over for Superiority and Achievement

LUDLUM SPECIAL STEELS **STEELS**
SPECIAL HARDENING SPECIAL HARDENING

THE SIXTH SENSE OF INDUSTRY

Tycos Temperature Control

If Sense of "Taste" Sufficed the Canning Industry!

The SIX SENSES Being Feeling Hearing Smelling Tasting and Tycos Temperature Control

Tycos Temperature Instruments
INDICATING • RECORDING • CONTROLLING



TO MAINTAIN LINCOLN REPUTE

More generous commendation has seldom been extended to a motor car than that evidenced in the readiness with which the Lincoln was accorded its place among the aristocracy of the automotive world

Although one of the youngest of fine cars it already has its traditions. The sound engineering embodied in its design, the faithful accuracy of its manufacture, the resultant faultless performance through many years of life—these have from the very first, been unanimously granted it.

It is the fixed determination of the vast organization now sponsoring the Lincoln that nothing in manufacturing practice or in sales and service policy shall be permitted to detract for one moment from this high standing in public esteem.

LINCOLN MOTOR COMPANY

DIVISION OF FORD MOTOR COMPANY DETROIT, MICHIGAN

The Four Passenger Phaeton

L I N C O L N



Ask your maintenance men to show you last month's repair bills on your industrial trucks. Then ask us to give you comparisons with Timken equipped trucks.



We'll
Fight
Friction
for you
Everywhere

THE TIMKEN ROLLER BEARING

MASTERS & SONS COMPANY

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See Bulletin 17

Trucks that Stay New

No matter how nearly perfect the mechanism of a lift truck may be otherwise, basic efficiency is impaired unless the wheel mountings are modernized.

That implies Timken Tapered Roller Bearings in the wheels. Timkens are particularly adapted to this service, because

In addition to radial loads, Timkens carry the severe thrust loads which result when a truck piled high with a heavy load weaves in and out through a crowded factory—

Timken enclosures retain the grease and require

lubricating only once or twice a year. The material hauled is protected from being soiled, and floors are kept free from grease—

Timkens completely eliminate axle wear by confining all wear to the bearings themselves—

And when wear in the bearing does eventually occur, Timken adjustability—an easy, quick operation which moves the tapered roller assembly a little farther into the tapered cup—makes the whole Timken Tapered Roller Bearing (and consequently the whole running gear) function as when new.

The Timken Roller Bearing Co
CANTON, OHIO

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TIMKEN
Tapered
ROLLER BEARINGS



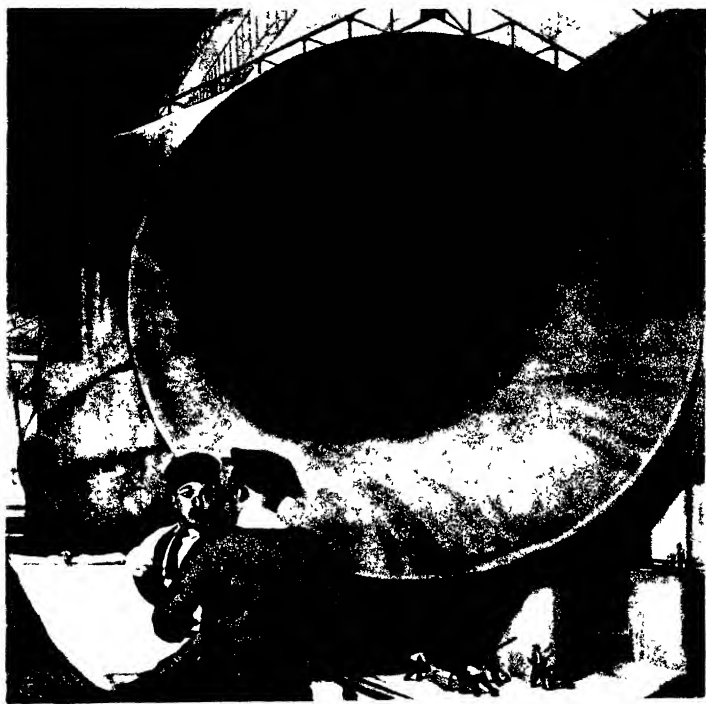
SCIENTIFIC AMERICAN

The Monthly Journal of Practical Information

35¢ a Copy

AUGUST 1923

\$4.00 a Year



WHERE FUTURE AIRCRAFT ARE TESTED—INTAKE END OF THE WIND TUNNEL [See page 86]

Scientific American Publishing Co., Munn & Co., New York.



The Crowley-Mulner Company, Detroit department store, operate over fifty Federal Trucks and make deliveries in a territory embracing fifty towns and cities in the vicinity of Detroit.

FEDERAL has spent hundreds of thousands of dollars on new design. ~Federal has prepared for the future needs of transportation by completely modernizing its entire line of sixteen motor truck models. That's why Federal is now out in front of competition ~and why Federals are establishing a new sales record.

Another **FEDERAL**
"Means Another Satisfied User"

THE FEDERAL MOTOR TRUCK COMPANY
 Detroit. Michigan.

HKB



10,000 Lives at Stake Reliance Placed in Ball-Bearing Fans

MAMMOTH incubators of this type are built with a capacity of over 10,000 eggs. The hatching of the maximum number of large healthy strong chicks from these eggs is dependent upon maintaining an equal distribution of heat throughout the egg chamber and upon continuous uniform ventilation. Failure to maintain the proper temperature and to remove poisonous gases as formed not only reduces the quality but also the quantity of the hatch.

Reliance is placed in electric fans equipped

with deep groove ball bearings made by the Hess-Bright Manufacturing Company to maintain an equal distribution of heat and to remove the poisonous gases. These fans are kept in continuous 24 hour a day operation for a period of five months and are giving complete satisfaction to thousands of users.

Whether your bearing problems lie in the field of industry, transportation or science ball bearings will give that reliability of performance and precision of operation which you seek.

THE HESS-BRIGHT MANUFACTURING COMPANY

Supervised by **ESSEX INDUSTRIES INC.** 165 Broadway New York City



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BALL BEARINGS
*The Highest Expression
of the Bearing Principle*

Planning in Terms of Tons and Cargoes

Watch the steel arm of a pontoon crane as it dips into a freighter's hold. See it again an instant later, laden with tons of cargo. The work of hours performed in minutes! Regardless of the weight or bulk of the material handled, this electrically operated crane moves deliberately—as it lifts, swings, lowers, and lifts again—deposing its load safely and speedily just where it is wanted.

Westinghouse Terminal Engineering

From the little portable winch that moves about the docks, to the great car dumpers that pick up a car of coal bodily and turn it upside down, there are electrical problems being met by Westinghouse Engineers.

The motive, of course, is economy—the need for conserving time and labor, the necessity for clearing the docks, and getting the ships to sea again—and

electrical handling is the answer.

It is a case of machine methods against hand methods, it means modernizing instead of clinging to the prohibitive handling costs of years ago. And it is requiring engineering, mechanical and commercial skill to successfully meet the conditions.

Westinghouse is admirably equipped to serve in this capacity.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY
Offices in all Principal Cities Representatives Everywhere



Westinghouse

© 1923 W. E. & M. Co.

Another 250,000 "Miler"



After delivering more than 75,000 miles of service to the city of Auburn, New York, this Model "D" 1911 Franklin, illustrated below, furnished Arthur Maddocks more than 175,000 miles of service without replacement of a single Timken Bearing. A total of 250,000 miles.

120,000 miles of these quarter million miles of service were delivered in and around the mountains of Colorado.

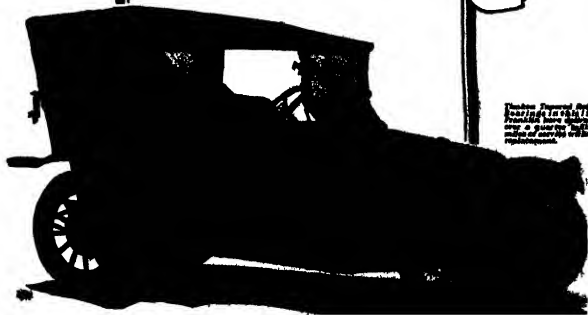
On the 28th day of April, 1923, Mr. Maddocks furnished the following affidavit made in Denver:

"During all the time I have had the car, which is from April 1, 1913 to date, the Timken Bearings were not replaced until April 22, 1923; and the Timken Bearings delivered to a representative of the Timken Roller Bearing Service and Sales Company are the same identical Timken Bearings that were in the car on the date purchased by me, and I have every reason to believe are the original bearings put in the car. From the present condition of the bearings in question, I believe they would easily last the life of the automobile, which is at this time in first class shape and which, during the next thirty days, will be converted into a service car to be used for towing."

Twelve years of service showing more than 250,000 miles without one single Timken replacement.

The Timken Roller Bearing Co
CANTON, OHIO

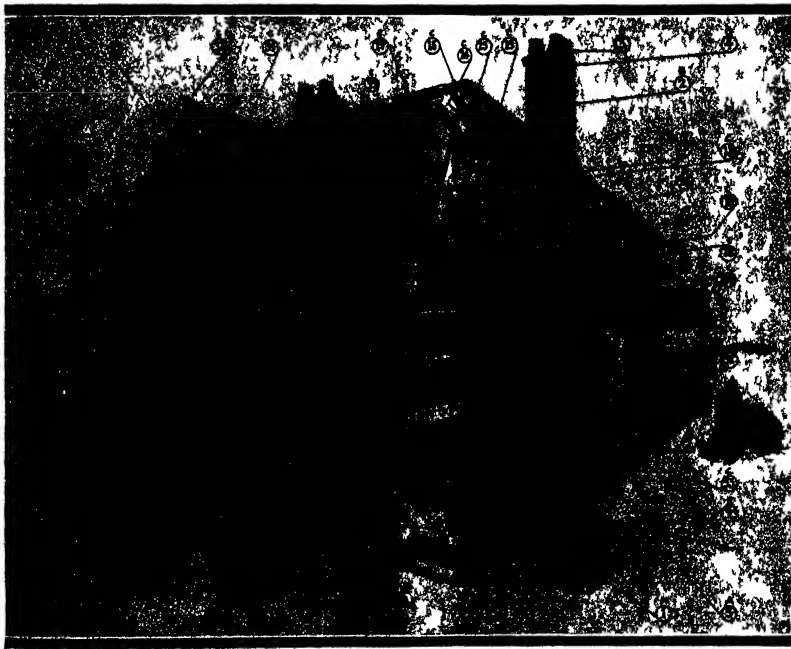
TIMKEN
Tapered
ROLLER BEARINGS



Timken Tapered Roller Bearings in this 1911 Franklin have kept it in a perfect condition for twelve years.

SCIENTIFIC AMERICAN

NEW YORK, AUGUST 1923

[illegible]

Features of a properly constructed brick and frame residence with the commonly used terms (see page 80)

Invention and the “Grifter”

Gathering in the Foolish Dimes and the Heedless Dollars at the Summer Amusement Parks

By Edward H. Smith

THE other Sunday at Oney Island some of us witnessed an example of the justly famed playful spectacle. A very brilliantly attired young man and his Paradisean sweetheart were plumb-bobbing. That is to say, they were standing before the booth of a confectionaire in tinseled dolls and perky candy, swinging a bowling ball, suspended from the roof of the little kiosk by a chain, in vain effort to knock down two fat-ton pins which stood on the counter in what seemed to be the easiest range of the confounding ball.

"The thing is an easy one to do—no soft as syrup!" cried the Barker insistently.

The bravely dressed young man paid his dime, pulled back the ball and let it go. Surely it would fly back in the direct projection of the pendulum and knock down the two pins, thereby winning the doll or the candy. But it didn't. It swung out, turned and flew back in ellipse, just wide enough to miss both pins.

"Pretty close, friend pretty close that time," sang the leatherlung. "Better try it again! See me do it! Just swing the ball right past this right pin here, like this, and—bingo! Down they go, every time. It's all a matter of skill."

The concessionaire, or grifter, to give him his native name, had indeed let the ball go just past the shoulder of the pin on the right and again it had travelled an ellipse, but so narrow that it touched the left pin as it swung back and sent both of them tumbling down.

"Try again, friend!" barked the Impremario blithely, setting up the pins with a meticulous care that escaped his customer's attention. The young man did try and failed. He tried again, growing redder and angrier as he saw the circling bull swish harmlessly past the pins once more. His bedimed young lady was full of enthusiasm and excitement.

"Let me do it, let me!" she urged, and the grifter gallantly indicated to his sputtering customer that this was the proper maneuver.

She tripped on her spindly heeled, carmine shoes and took hold of the heavy ball. After a good deal of giggling and sniggering she aimed her shot. The ellipse was almost a circle.

"No, no, no, Miss" complained the grifter in earnest imitation of torture "You mustn't swing it wide You must cut just pahst the shouladah of the pin beah Let me help you"

None but a practiced eye would have noticed him pick up the right pin, give it a half turn in his hands and then set it down again very carefully on the spot.

Guiding the young woman's shot he let her send the ball flying past the pin by a hair's breadth. It swung away, stopped and swung almost directly back in the true poudgular course. Straight between the two pins it plunged and down they went to the amusement of the crowd, the intense delight of the young thing and the black disgust of the young man.

Needless to say the grifter immediately handed over a tinelled doll of the girl's selection and invited her to try again. She looked for encouragement to the young man and then did risk half a dozen more shots. But now, alas, she could not wig. Her escort, still angry over his own failure and discomitted by her single success, took the bait and began to shoot again. He missed thrice and went away fuming, having paid about two dollars for a doll worth forty cents.

The call of the bilthe entrepreneur of summer amusement followed him down the walk:

"Step right up, ladies and gentlemen
All a matter of skill, friends. All skill
Just a game of skill!"

But was it? And when the millions rush to the summer parks, the sea shore, the picnic, the street carnivals and

loon blowing game. The rubber balloon here is in the throat of a customer as the customer pulls a lever, and the winning frog is the one who blows first. But—the game keeper usually has mechanical control that enables him to make any given frog win.

wherever grifters and their alluring games are appearing this season, will it be a mere lack of skill that sends a would-be grifter off of good money into the hands of those that "trawl" him? Or is it the lack of the man with his ball and ten pins. That right pin had been carefully slanted off on the bottom, so that when he hit it it spun like a top? Or was it the fellow who perhaps half an inch at the top. That was sufficient to send the ball into an ellipse wide enough to miss invariably. But when he wanted some one to win, in fact it was the grifter who was the one who was the pin ball around so that it won't lean a full inch near in. No, the ball sent just past the in-leaving pin made. Almost directly back and winning was un-missable.

A trick of this sort is called a gimmick or grout—and that term is the Aladdin's ring that gives us sesame into the land of summer folly, of grifters, concessions, games, rides, hot dogs and ballyhoo.

One seldom stops to think of it, but a very large most of

Flum bobbing; an officer inspecting the outfit to see whether it is really game of skill as represented. The object is to drop both men with one swim of the ball.

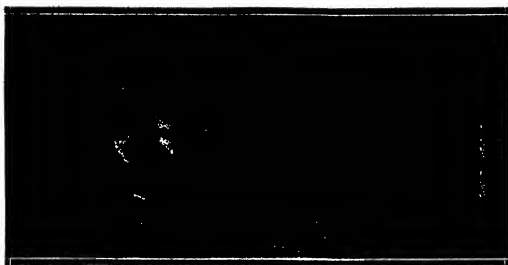
which that comes the very old notion that handshakes and halftone are lucky. They have been carried about by the mountebanks of many countries and always allowed to win, so that the galled crowd might be tempted to play and lose its cash. On the other hand, if the woman beside you suddenly wins with her first or second play and dashes off with some flashy prize, you may be sure the grifter has thrown the game her way both to encourage play among the onlookers and to send her wandering about the park with her eye-rolling award, thereby advertising the grifter's game.

Perhaps you have yourself stepped up to one of these games where several were playing, and won miserably at the first venture. If you will note carefully you will discover that this doesn't happen unless there is a crowd behind you. Your good fortune is the lure by which the others are coaxed on to it.

But perhaps the simplest way to make the whole business clear is to take up a few of the representative summer park and carnival games and explain how they are grifted. Let us begin with the old and ever-popular hoopla. This is the generic term for all forms of games where the aim is to throw a ring or hoop over an object to be won a prize which is ever larger, but not perceptibly so, seen with the naked eye at a little distance. (When the crowd becomes restive at repeated losses or poor victories the grifter now commonly called slack, stepped up and was of course given some of the larger rings. He immediately won the most coins or umbrellas in the rack, laughed raucously at the mock discomfited grifter and strolled away with his prize. The crowd, of course, surged forward to take advantage of a "turn in the luck." But the grifterman behind the counter wasn't pausing out any larger rings just then.)

Some hoopla games belong to the order known as "flash and slum joints." In the language of the vaillant summer showman "flash" means the big showy prizes offered at various booths. Slum on the other hand refers to the worthless small wares. Thus in the Japanese rollball game to be seen along every board walk in the land, the big showy prizes of Batavia the expensive sets and large vases are "the flash." The little match trays and ash receivers are the slum. In this game as in all others no one wins the "flash" without paying from three to fifty times its value. However, in those roll ball games the big pieces can be won if one has patience and money enough to stick to it.

In the "flash and slum" hoopla booths, on the other hand, the big prizes are never won by any but the shillbills. Watches are much used in these places and the cleverest grifter uses the American movements in solid gold or even platinum cases, watches worth up to two hundred dollars. But on the next with one of these cheap watches, worth only a few cents, he is able to do the trick. In



Poker with darts—try to get four aces if you can

the former case nothing but the slum is won in the latter only a shillbill is allowed rings large enough to do the trick. You pay for no more and you take no medicine.

There is always about all carnival parks and street fairs the kind of man known to the inner circles as a half wise boob one who can not easily be duped because he has that little know-kick that is so dangerous. For the humiliation of this kind of man the grifter has various mechanisms at his command, a double gimmick. The shillbiller is acquainted with the first but not the second.

Some years ago I was standing in a Chicago amusement park with a young man. I knew all his hair strolled up to a booth where a well known grifter was conducting a little trick game. The gamekeeper tried to interest this youth in his sport but met with the swamering answer.

"Watch this in a d d d d d I'm wise but I can't do it. All right son, I'll show you and immediately pulled out a curiously designed knife. He opened the blade and began carrying a bit of wood.

The grifter is even fonder of the knife. In a moment he had made some comment as to it. Betcha a quarter you can't do it," said the grifter instantly.

The young man's breast swelled with injured dignity. "I can't," he snapped. The bet was made and the knife landed over. Try as he would he could not close it on the blade. He began to say "I can't do it" without destroying it.

The grifter laughed loudly, picked the wise young man's money and benignly showed his new friend

Aw this is easy

Open it

The wise young man of course received such a proposition with derision.

"How much do you bet?" he demanded.

"Fifty dollars."

The grifter, seeing from the wisemonger's attitude that he didn't have that much, nudged him and whisperingly inquired how much he bet.

"I only bet forty," said the dope.

But this urged the grifter under his voice "I'll take the other ten."

So the bet was made the newcomer closed the knife, the grifter held the stick and the young man tried to open the blade. He tried till he was blue in the face and couldn't stir it. Then the grifter regretfully paid the bet to the stranger who went his way rejoicing.

But it said the grifter when the other man had gone. That guy knew more than I did. I didn't think there was a double gimmick on that knife.

The stranger needn't to any had been the grifter's shillbiller.

Such ingenious little instruments of fraud are being invented and manufactured constantly and discarded in favor of new ones as they become too widely known.

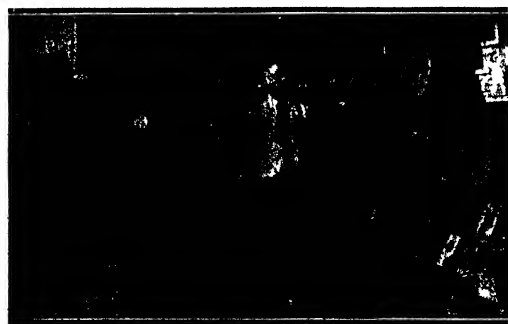
In many years as you have walked into parks and street fairs you've had been caught by the man with the series of little tin cans hooked or ribbed or the triangle of little wooden barrels. The trick is to make three balls travel into these receptacles at the same time. You say there. All if you have tried it again and again. It looks extraneously simple but the balls always bounce out again.

Let one throw even so gently, out they go and the prize is lost. But the fellow next to us makes them stick. How come?

This game is called Huckle-ey Buck or Huckle-ey Buck, depending on whether one talks to an Eastern or Western grifter and it is man need to a hundred fashions. It is one of the classics of perfidious. Of course it is grifted. Last summer at one of the principal parks I saw a well-to-do old grifter a man who had come through all the imaginable splendors and vicissitudes of life with a fair and snail moving live chickens or ducks against the dime of the tin in no time. No one won till I stepped up under the arm of a famous old count and grifter. The grifter recognized us instantly and in a twinkling to play. My friend did so at once and soon won four ducks.

Keep on for me till I come by will you?" he asked.

"Surest thing old man," said the grifter without the (Continued on page 122)



A recent adaptation of Huckle-ey Buck. The trick is to make the exceedingly springy tennis balls stay in the bucket. This time there is no cheat—except that it is just naturally so hard to do that you more than pay for any prize you win.

The Paper of the Future

Means, Ready to Hand, for Staving Off the Impending Famine in this Essential Material

By S. G. Roberts



A monument to waste—the train burner at a southern yellow-pine sawmill

OUR DAILY newspapers and our printing presses generally are using up annually a vast amount of paper stock which has been diametrically drawn its raw material from timberlands. The public at large gives little heed to the significance of this drain—the citizenry is concerned only in getting enough reading matter to satisfy its more or less avid demand for news, information and entertainment.

Two years ago we employed in the manufacture of paper more than 5,000,000 cords of pulpwood, and the point to be kept in mind is that the rate of this consumption of the available stands of timber is steadily climbing higher and higher. Both the authorities of the United States Department of Agriculture and the officials of the American Paper and Pulp Association have studied the situation with no small measure of alarm, recognizing how many industries rely, either directly or indirectly, upon an abundance of pulpwood, wood pulp, and the finished paper made therefrom.

The American Paper and Pulp Association emphasized a short while ago that we have become increasingly dependent upon foreign forests in the last seventeen years for a big share of the wood pulp used by our paper mills, and this despite the augmented utilization of domestic wood. It seems that of the total consumption of the available stands of timber is steadily climbing higher and higher. Both the authorities of the United States Department of Agriculture and the officials of the American Paper and Pulp Association have studied the situation with no small measure of alarm, recognizing how many industries rely, either directly or indirectly, upon an abundance of pulpwood, wood pulp, and the finished paper made therefrom.

The association declares that "the timber forest lands of the eastern United States, under proper management, could be made to produce the needed wood supply in this project will pile up the eventual cost." This wide-awake organization pertinently asks: "Why not begin now?" The purpose of this article is to reveal some of the promising work that has been done in this direction and to show how an apparent waste can be turned into a gain of great economic moment.

At the present time, the manufacture of the wood pulp is, for the most part, concentrated in the New England, the Middle Atlantic, and the Great Lakes States, where formerly there were abundant local stands of spruce. Now, over the wood for these mills generally comes from afar, and there are places in New York State, that obtain their raw material from Canada, which ships to pay around \$40 a ton for the de-

livered pulpwood. At the point of shipping, the average price of that wood was approximately \$12 a cord. Broadly stated, it requires about one and one-half cords of non-renewable logs to yield one ton of wood pulp. Manifestly, the cost of the finished product will increase as the journey from the forests to the mill is lengthened. The pulpwood consumed by our pulp manufacturers in 1920 entailed an expenditure of \$116,405,720.

Down in the Southern States, where the long-leaf yellow pine dominates, the forests are being stripped of their timber at the rate of nearly 4,000,000 acres annually. There are today more than 20,000,000 acres of these denuded tracts in the Southland, and because of the difficulties incident to removing the stumps probably not one-tenth of these quagmire forests have been made fit for agriculture, even though the potential productivity of the soil is fully recognized. Moreover, when one of these reforestation plans is belied only about one-third of the tree ever reaches the market in the form of lumber; and the prevalent wasteful methods of fapping the pines for turpentine are killing yearly an appalling number of them. But why concern ourselves with the reforestation plans when reforestation is utilized to but a minor extent in the making of paper? Because long-leaf yellow pines offer the means by which to decentralize our paper-making industry and assure us an enormous quantity of raw material which can be put to use in the manufacture of wood pulp and of by-products of great value.

Of the several essential processes for the pulping of wood, the sulfate process is the one peculiarly suited to deal successfully with resinous woods, and it is this process which bids fair to give economic importance to the big stumped-out areas in the South which have hitherto been deemed little better than worthless. The limbo of the new era is the climax of the efforts of engineers, chemists, and business men, during the past seventy-odd years, who have striven along three main lines to garner the wealth stored in those billions of charred or weather-blackened stumps. Lately, this subject has engaged the attention of a group of New York industrial engineers, and their achievements both in full-sized plants and in a miniature duplicate of a commercial mill have opened a sure way for future operations on an extensive scale. This is the outcome of substantially six years of research.

Before describing what Joseph H. Wallace and his associates have made practicable, it might be well to outline the paths previously pursued by inventive genius in approaching this problem of conservation. The first of the noted methods was to burn the charcoal from the stumps and the trash wood by subjecting them to destructive distillation, the value of these charred products being estimated upon the basis of the cost of clearing the land. Since pine oils have become useful in the flotation treatment of certain

minerals, this utilization of forest waste has proved moderately profitable.

The next endeavor was to tap the treasure house of vegetal riches by means of the so-called "steam-and-solvent" process. The procedure consisted in cutting the wood into fine chips, and then forcing the chips in a closed vessel under sufficient pressure to distill off the turpentine—the residual waste being left after the turpentine had been distilled off. This process became commercially worth while only when it was discovered that resin could be extracted in paying quantities if the by-product chips were acted upon by a suitable solvent.

The third essay sought primarily to put the fiber of the wood to service in the manufacture of pulp and paper. The resinous nature of the raw material, however, offered a serious stumbling block to this undertaking, inasmuch as the wood would not yield readily to the acid pulp methods commonly relied upon by the industry. Such was the state of the problem in 1905, when it was learned here that paper mills in Scandinavia were getting good results with the sulfate process when handling wood containing considerable resin. Following very promising work in their laboratory, in producing chemical fiber and paper from yellow pine waste, Mr. Wallace and his collaborators shipped a quantity of kindred raw material abroad and made a demonstrating commercial run in a Swedish mill. The outcome was highly gratifying. As an after-math, a large mill was built in Minnesota in 1912-13, and it was possible there to turn out chemical pulp and Kraft wrapping paper at a lower cost than had ever been feasible elsewhere. Since that time a mill has been established in the South alone, and they have uniformly demonstrated the value of waste yellow-pine wood as a basic substance for the manufacture of pulp and paper.

While the three foregoing methods have proved commercially successful in varying degree, still none of them recovers a large percentage of the total wealth latent in the old stumps and in the logging waste of the region under consideration. For the most part, the various processes have been operated independently of one another and with little regard to their economic correlation. In short, taking the business as a whole, it has lacked stability.

It should be borne in mind that the woody fiber, so essential to the production of pulp for paper making, is destroyed when the wood is subjected to destructive distillation or when it is treated by the steam-and-solvent process. For industrial purposes, the cellulose of the pine is worth fully as much as all of the other substances and oils that can be produced from the fiber in the matters of strength and pliability is especially notable. Therefore it is most desirable that the wood be made to produce the maximum amount of this essential material. And now we come to the most heartening aspect of this whole subject, the story of how the new research has revealed ways by which several processes can be coordinated and so yield the cut-over pine lands, valued at present at about \$5 an acre, can be made to give a net return of substantially \$200 per acre from the curing stumps and wood trash—leaving the cleared areas available for farming or for other uses.

Again, Mr. Wallace and his co-workers have revealed a solution of a complex problem through the means of laboratory studies and the consequences of their investigations, begun in 1913, if they are made to give a net return of substantially \$200 per acre from the curing stumps and wood trash—leaving the cleared areas available for farming or for other uses.

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Cotton growing on southern land, formerly waste, but from which the stumps that made a worthless tract have now been cleared. And the stumps can be made into paper!

ward appearance of dead wood, still beneath this cloak is a wealth of untapped fiber and an amazing amount of valuable matter. Almost two, twenty, and thirty years of age, as a rule, substantially sound and capable of yielding prime wood pulp and paying quantities of sawed naval stores.

The new and coordinated system embraces the three following outstanding activities:

1. The manufacture of chemical fiber suitable for the making of Kraft wrapping paper book paper, and test board.

2. The hydropneumatic manufacture of such naval stores as turpentine, pine oil, and resin.

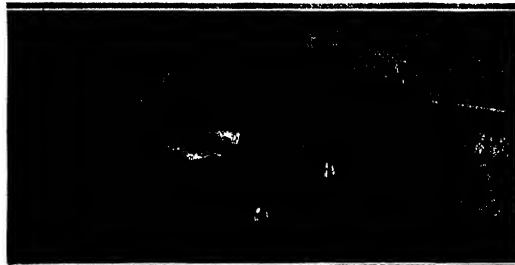
3. The destructive distillation of wood—transformable for fiber—for the purpose of producing acid, flotation oils, etc., as well as a residual fuel useful in carrying on some of the operations.

In a broad way, the intention is to divide the work between what might be termed semi-portable field plants and permanent mills conveniently located—the field plants serving as feeders to the latter. Using the processes perfected by the technicians in question the field equipment will turn out turpentine, pine oil, resin, pyroigneous acid, and tar in addition to the main product, pulp chips of a uniform moisture acid and resin content. A standardized chip is something that has long been lacking and yet a factor very much to be desired in the chemical wood pulp industry. In the absence of it, the making of pulp for paper has been attended with many uncertainties such as the time consumed during some of the stages of preparation, the probable chemical composition of the chips and varying physical qualities that might cover a considerable range. These uncertainties have added greatly to manufacturing costs, and all too frequently have meant the difference between profit and loss.

We are assured that no more complicated apparatus is required than ordinarily found in the run of saw mills and that the labor need be no more skilled. The application of the method involves only the mechanical work along pre-determined lines and the turpentine oil, and resin extracted from the chips are of a superior grade. It follows of course, that the use of a standardized material for pulp making insures a better product, and the experts also claim that it is practicable to get an increased yield. The marked effectiveness of the procedure employed in taking naval stores from the red-

clips is principally due to the action of a selective solvent. The nature of this, however has not yet been made public. Experiments have proved that the most valuable of the low grade residues material remaining in the chips after exposure to the solvent does not warrant its removal in advance of pulping. Besides, this residue can matter serves as fuel in the subsequent recovery of the chemicals utilized in pulp making.

The survey of the pine lands in Texas for instance has shown that there is commercially available per acre an average of 754 cords of pulpwood and 456 cords of trash wood. Taking the prices prevailing last year the 754 cords of pulpwood would yield 854 tons of Kraft paper worth \$275 from the chips preliminary to pulping the field plant would extract prime naval stores to the value of \$147.00 and the treatment of the trash wood by destructive distillation would give turpentine, pine oil, tar and pitch a value of \$10.00 making a total return of \$20.00 per acre. This figure does not include the value of the fuel that must be burned to run the distillation plant or of the solvent obtained during one stage in the operative cycle of the entire system. It is estimated that an outlay of \$30 per acre would cover the charge for clearing it, \$15 for the land and \$15 for the material taken therefrom. Apropos of this whole subject if a more economical employment of waste pine wood it should be pointed out that sawmill refuse is plentiful throughout the southern States and this waste can be had for pulp making in high unlimited quantities at \$1.00 a cord. Aside from this source of supply however the abundant waste material in the pine lands and timber lands to keep the modern system going on a



The miniature testing engine, a faithful duplicate of a regular paper mill machine, which has been used to test the strength of yellow-pine stamps can be turned to a handsome profit.

splendid place for three or four decades to come. Further by replanting the cleared area with yellow pine seedlings a second market is opened for lumber and for pulping purposes. In a century of time the cleared area will be covered with pine fully twice as fast as the northern species.

A fact not generally realized is that the entire fiber from yellow pine wood waste is by no means limited to the making of wrapping envelope and bag paper, nor to match box and carton boards of the higher grades but is equally applicable to the manufacture of many other classes of fiber products. A book manufacturing, stationery, writing paper, etc. It is authoritative stated that in whatever directions chemical fiber now dominates the field because of its virtues as a diffusive filter from our southern pine waste will for the same reasons eventually sweep away while in all branches of papermaking where fiber strength may be an important consideration this newer commodity will outrank all of its competitors.

Finally by clearing off the cut-over pine lands in the manner described, great areas will be made available for agricultural development and where tracts have thus been turned into farms the abundant productivity of the soil has been demonstrated conclusively. This is a matter of vital moment to millions of our citizenry.

Radiant Heat Versus a Gale

DURING the coldest days of the winter pedestrians are sometimes seen by the corner store window in New York were almost without exception to jump slightly as they unexpectedly and suddenly came within



The digester and diffuser employed in demonstrating, on a laboratory scale, the practicability of making paper from the pulping wastes so plentiful in the southern States.

the invisible shaft of radiant heat thrown out across the sidewalk by a mammoth electric bowl burner made only for advertising purposes and using about fifteen times as much energy as the common bowl burner such as is often used to heat a bathroom on a cool morning. One of the most remarkable things about this method of heating is that it is not affected by any degree of wind the wind does not blow the heat away or to one side in the slightest degree. Moreover the heat passes through the intervening air and glass without heating it. These characteristics set up a fine illustration of the difference between radiant heat and sensible heat, which if it is new is required are two separate and different things. It is not a glow, but a name. Is it not true then, that radiant heat and sensible heat are both forms of heat? Would they not be both heat the heat the heat brought to them? The truth is, both kinds have the same report to the human nerves. But the one sensible heat is the only one we have now—our means of perceiving while the other radiant heat gives us no report at all until it has impinged upon our skin where the other where it is which constitutes radiant heat set up molecular vibrations which are named as heat. What we then perceive is not the radiant heat at all but the effect of it translated into the same molecular vibrations that occur in a piece of hot iron. A hot iron can warm the air around it but the power of radiant heat will not for it is not transmitted by the air but by the other. The light it finds the air no obstruction. When it strikes an opaque object however it stops and its molecules into vibration that is, warms it and from this it is given up to the air as sensible heat of the same to which we are accustomed.

Since the earth is in no way influenced by the wind the beam of radiant heat reaches out into the winter breeze passing through the window without heating it, except in a slight degree owing to the presence of impurities in the glass. The beam of heat thrown by an ordinary automobile headlight will be very strongly felt if we step in front of it when the car is standing whether there is a calm or a strong wind. If a radiant electric heat were placed in a room having walls of high grade glass that would be no beating of the room. But if some opaque object were placed in line with the heat ray or beam such as a piece of furniture the room would soon warm up.

Small-commercial extraction plant used in developing a process for the manufacture of high-grade naval stores in competition with the large-scale utilization of yellow-pine wastes.

Our Point of View

Our First Psychic Tests

PHYSICIAN REPORT on Mr. Mason's got into the July issue of our paper a form of the press after printing and comment. The page corresponding, to the present one how ever was so far advanced that editorial comment necessarily went over until now. Such comment must take several directions.

Adherents of the medium have described to us phenomena obtained in their presence which go far beyond anything done by us or which we have attempted to reproduce. They would call either for genuine mediumship or for extraneous confederates. These manifestations as we have not felt called upon to explain or to deny. We have no concern with what the medium has done at other times and places and under other conditions than ours. All we need say and all we can say is that there was no evidence that the phenomena produced for us were genuine with these was every indication that they were not. Our Committee's conservative statement is due not to absence of conviction but merely to action. It is possible to explain a wide variety of results which the investigation had covered.

Our electrical apparatus has not been questioned for so, but it did not seem expressed that its data can lead to so vituperative a conclusion. Its sensitivity was such that a weight of nine pounds in the medium's chair was sufficient to keep the little lamp a light. This should dispose of any idea that its recorded lapses were due to the medium's responsiveness, and it should laugh out of court the suggestion that enough ectoplasm was abstracted from the medium to bring, his weight below the sensitive limit. It should also dispose of the claim that the medium was in no species of trance should out law the various other oblique explanations of his activity. The claim is made that fifteen seconds is an absurdly brief interval to cavil at a man on, but this is utterly contrary to fact—in terms of the simple phenomena of these cases fifteen seconds is an enormous time.

Numerous lay folk of the infamously hard headed type have scoffed at the elaborate methods used. It is much surer that to trip a medium they may as well make only to flash a light. Hoping sarcastically we should exclaim "What a gift we did not think of that!" Meeting these gentlemen on their own level we should point out that after sitting in total darkness for an hour or more the medium is in a position that would leave one blind and confused for a time quite sufficient to enable any man, suspicious to be covered up. Making the simplest statement that we had just shown that a flash a light we should do better not far over the heads of these critics. But even so they must read the details of experience. Surely the way to establish our vivacity against the medium is not to start from a broken pipe surely the way to get more mediums to come forward is not to employ bar-room tactics with the first applicant. If questioned why we use such methods a proper answer may be again on the ground of expediency—though we prefer to say by saying more than that we are not investigators of the sort who "leave the light and attempt to dis count them in advance on this expectation. We hope the outcome of our first tests will have spiced this idea that we are convinced before we start and will have made it clear that any favorable report which we may render will be based upon facts calling for such report.

On the other hand, plain people will be relieved

that our conditions and procedure were proper. Indeed, when sitting under very sharp controls, the medium felt so free from restraint that he displayed some impatience to know when the tightening-up process was to begin. We may say very frankly that in our view anybody who objects to the conditions of our tests in any way inhibitive of the best action of the psychic forces would better admit explicitly that any apparatus or any methods whatever that look toward the prevention or defeat of fraud are inadvisable.

It should be remembered that we have not met with all mediums, or even with a medium of wide reputation generally admitted to have produced surprising results under reasonably severe conditions. We have met with a single medium and have had a very mediocre performance not even up to the standard of high-grade fraud. Total darkness made it a matter of some shame to demonstrate its true nature but that is the best that can be said for it.

Accordingly, it is necessary to refrain from drawing unduly general conclusions from the present findings, and this necessity cuts two ways. That all mediums are frauds and all phenomena fraudulent is either true or false; but nothing tending to establish its truth or falsity has come out of these three sessions. On the slender basis one might as well conclude that all men are from Pennsylvania as that all larders in crickery. Equally one should not get the idea that psychic researchers are entirely without merit and with nothing less trivial than the phenomena presented to us by this medium. The charge of incompetence has been brought against psychic investigators in general because of the small number in this field of case, but such charge is quite contrary to the facts, and demonstrates only the ignorance of those who bring it.

Mr. Lasker on the Shipping Board

THE PERIOD of two years, for which Mr. Lasker, at the request of President Harding agreed to undertake the chairmanship of the Shipping Board and endeavor to bring order out of chaos having elapsed he announced his retirement and in a report to the President gave a concise statement of what he had accomplished in his gigantic task of airways and organization.

A gigantic task truly for not only was the investment of public funds three times that of any commercial enterprise in history, but he had to contend with effort and impracticability as such, it was an attempt to create a vast merchant marine by compressing into months the natural growth of generations, and inevitably "was doomed to disaster." Thus Mr. Lasker tells us that the administration of the fleet was not remotely competent that the boats had lost the confidence of American exporters; the operating deficits averaged \$100,000 a month, "no accounting system worthy of the name existed and an unrecorded number of \$100,000,000 war claims remained to be settled.

One of the absolutely insoluble situations confronting the new Board was the 50 shipping companies, who had bought 184 ships at war-time prices, and because of an 80 per cent decline in ship values, were bankrupt or facing bankruptcy. After months of study, 40 of these concerns were rescued and "preserved for the American flag." The Shipping Board has now "the most complete and accurate accounting system in the Government service," and the Director of the Budget recently stated that "the Shipping Board is the only Government agency with a monthly trial balance." By June 30 the Board had practically settled 12 cents on the dollar the shore-transported claims amounting to \$100,000,000.

The Economy Fleet Corporation, charged with the commercial operation of the ships, has reduced the monthly deficit of \$18,000,000 to \$4,000,000 a month, and has provided nearly two-sevenths freight lines, giving efficient service on every ocean route. The passenger and freight ships flying the American flag have brought the United States six days closer to South America,

and in the Pacific are rapidly expanding trade relations with the Orient. It is believed that with the entry of the "Leviathan" and her sisters we shall witness a new era in the North Atlantic, where the competition is keenest.

On taking office, the Chairman promised to offer a policy which might prove the basis of a permanent merchant marine. On this score Mr. Lasker emphasizes the fundamental difficulty that physical operation costs are from 10 to 15 per cent more than on foreign vessels, the difference being due to legislative restrictions higher capital charges, better wages and better living conditions for the crews. The so-called subsidy bill aimed to equalize the conditions. Since Congress failed to pass this measure, "the apparent alternative is to go the full length of Government operation." Because of the inherent disadvantages of the Government as compared with private ownership, the Board has advertised its established lines for sale. The result has been disappointing, and, in view of this, it is believed that "the Government is warranted in assuming the task of direct operation." Justification is found in the guarantee thus afforded, of an adequate merchant marine in the event of war.

Mr. Lasker recommends the operation by the Fleet Corporation of twelve to eighteen subsidiary corporations, whose general policies it shall control. This control should be exercised by the Government, private owners of such a company will call for the surrender of 2,000,000 deadweight tons. This will have 1200 surplus ships many of which are impracticable and should be broken up. Of the 2000 ships over 1,500,000 tons deadweight should be selected as a reserve. The above vessels plus our coastwise ships, would give us a merchant marine of 7,500,000 tons deadweight, a total which would place us in second position among the maritime powers.

The Demand for Air Laws

DURING the year 1922 there were 184 airplane accidents involving 63 fatalities, and 107 persons were injured through airplane accidents. An analysis of this record by the American Chamber of Commerce of America, as given in its annual report to the Secretary of Commerce, strongly stresses the fact that, if casualties are to be reduced, the Government must provide adequate legal jurisdiction over all civil flying. "Why civil flying is specified will be obvious from the following facts:

In 1921 approximately 1200 civilian airplanes were in operation. Of these, 1000 were owned by private owners, 200 were owned by individuals and organizations who possessed fixed bases and practiced conservative business policies. An equal number were distributed among "hobbyist pilots" who have no particular system and depend for a living upon touring, barnstorming, tours and extra hazardous assignments. In view of these facts, we are not surprised to learn that during the year there were 128 accidents among the 1000 "hobby pilot" and only 12 among the fixed base operators. These accidents, we are told, resulted in 63 fatalities among the group pilots and only seven among the fixed-base operators. Analyzing the accidents among flying flyers, the report states that 87 were due to lack of inspection of their equipment, and that three would have been prevented by Government inspection and other regulations. "From piloting caused 66 accidents, 38 were caused by weathering, 11 were caused by overloading in the flying, 14 by loss of control of airplane, and 10 were due to lack of direction of the pilot as a result of which the pilot believed that he would divert all their energy."

The Economy Fleet Corporation is the largest of the United States' Federal agencies. Year after year our Government has been urged to pass laws for the regulation of flying and the licensing of pilots, and, until now, the Government has been slow to do so. It is not until this year that the Government has taken any steps to regulate the nation. It is not until this year that the Government has taken any steps to regulate the nation. It is not until this year that the Government has taken any steps to regulate the nation.

Our Point of View

transferee disturb the public mind and prevent people from investing in a transportation enterprise which they wrongly believe to be not yet feasible or practicable. No thoughtful person who contemplates the achievements in aviation can doubt that it is destined to prove as serviceable in power as it did in the World War, but its extensive commercial development will never be assured until Congress is aroused from its present inattention. This arousing will come just as soon as a continental flying program to hear upon their representatives to pass the greatly needed legislation.

Does Railroad Electrification Pay?

THE QUESTION as to whether the change from steam to electric traction on main-line railroads results in a net profit, is difficult to answer. Many notable substitutions of this kind have been made on our main railroad system, the first great measure of the kind being the electrification of the four-track system of the New Haven Railroad between New York and New Haven. It is true that in the total length of line thus converted there are others which surpass it, notably the electrified mountain division of the Chicago, Milwaukee and St. Paul Railroad. The preeminence of the New Haven electrification is due to the fact that it covers a short-track main line which carries an extremely heavy passenger traffic, probably the heaviest of its kind in the world, by way of making it a heavy freight traffic. The work involved the service into and out of the New York terminal, with the immense amount of switching and the multiplied train movements, both passenger and freight, which are involved in a great terminal of this kind.

The electrification of the New Haven system was forced upon the company by the legislative demand that they should abolish steam traction at the New York terminal, and the change was regarded in railroad circles as a more or less doubtful experiment on a vast scale. The original installation covering the 35 miles from New York to Stamford, Conn., was followed by extension of the electrification to New Haven, and then the complete electric operation of the heavy freight traffic. Naturally, the engineering world has awaited with no little interest the publication of the relative economy of steam and electric traction, developed on this great scale. The results have recently been made public in an article by Mr. William R. Murray, chief engineer of the New Haven System, in an article published in the *Railway Review*, in which the writer emphasizes the fact that while the "direct" savings can be accurately tabulated, the savings in maintenance which will not in themselves usually justify electrification—this because of the heavy overhead charges due to the high first cost and other considerations.

On the score of direct savings due to reduced fuel consumption and motive power maintenance, we are told that, even after allowing for present decrease in steam locomotive coal consumption, due to the use of superheated steam and other improvements, the annual saving in fuel due to electric operation is about 200,000 tons of coal per year. The significance of this result will be appreciated when we learn that the electrified rolling-stock includes 100 electric locomotives and 70 multiple-unit cars with an annual mileage of 4,628,000 locomotive-miles per year, 8,847,000 car-miles per year, and 3,617,000 freight-car-miles per year. On the other hand, the savings against electrification include interest, depreciation and losses on the heavy electrical investment, the operation and maintenance of the transmission and distribution systems, and other minor items of cost which do not figure in the cost saving, as given above.

To the great of electrification are to be placed the saving in accidents and the saving in time resulting from the change. These multiple-unit freight cars have shown excellent switching and double-track movements, and the saving in operating expenses during the winter months of fuel and heating. Also the saving in the repair shop facilities has been postponed

for a number of years. And the credit for the saving in the cost of each construction must be granted to the electrification. Furthermore, the passenger tracks at the Grand Central are on two levels something which would be impossible under steam operation. Therefore, electrification must be credited with having produced the necessary terminal area, which under steam operation would have to be twice what it now is. Also most important is the fact that the area above the present terminal is available for commercial buildings, and the revenues from this source are so told if capitalized, amount to more than the entire cost of installation in both the New York Central and New Haven electrified areas. This, of course, is a special local condition and will never apply in the electrification of stretches of main line which include no great city terminal.

Saving 160,000,000 Tons of Coal

THE HAVE an economical problem confronting the United States today that makes a more important demand for close attention than that of the conservation of our fuel resources. The annual consumption of coal and oil is increasing so fast as to lay heavy emphasis upon the prediction, so frequently made in these days by competent authorities, that the exhaustion of our fuel supplies is being brought within measurable distance. Hence it is an imperative duty laid upon all large users of fuel, both to practice economy in its consumption and to utilize every possible medium for the saving of fuel. The most prominent among these is water power, which the great rivers, streams and lakes of this country afford a vast potential supply.

Of the many projects which have been considered and worked out on a practicable basis, the most ambitious and most carefully elaborated is that known as the super-power zone, which comprises the territory extending from Boston to Washington and reaches inland from the coast for a distance of 150 miles. Speaking of this project, Mr. William R. Murray, chairman of the Super-Power Survey Commission of the United States Geological Survey, recently said: "If the electric utilities within this zone were to meet the future load requirements by extending their power facilities jointly in the construction of large hydro-electric and steam-electric plants they would save yearly 160,000,000 tons of coal." He based this statement on the fact that the average fuel consumption of these utilities during 1918 was 2.75 million tons per hour, and that if we were to include the coal rate for the railroads and the industries, this would mean that the coal figure would be changed to not more than four million tons of coal per hour.

We have made wonderful strides in the development and use of electric power, but Mr. Murray points out that the last and greatest need of electric utility expansion is still ahead of us. He believes that ultimately the separate electric utilities will go out of the power production business, and that they will receive wholesale electric energy from certain great power companies. These companies will be entirely outside of the corporate existence of the various electric utility companies, whose function, therefore, will be to distribute energy, so needed, to the customers within their franchised territorial limits.

The super-power zone scheme involves of course a large expenditure upon the hydro-electric development of the Niagara and St. Lawrence Rivers, and in the close of his address at the recent commencement of Lehigh University Mr. Murray gave in some details his calculations of the amount of power which is running to waste on these rivers. Translating his totals into terms of coal consumption, he made the utilization of these rivers would result in a saving of about 160,000,000 tons of coal annually.

The Government is an ardent believer in the merits of the super-power zone scheme, and in the economic utilization of the immense reservoir of potential

energy with which nature has enriched the United States on its northeastern borders. We say this with full consciousness of the sacrifices which would be in view of the spectacular features of the Niagara River, but in view of the rapid increase of our population with corresponding increase in the demand for power, that this at least is one instance where sentimental considerations must ultimately bow to the stern demands of utility.

A Great American Venture

THE PLACING of the "Leviathan" on the trans-Atlantic route in competition with the long established foreign lines is the greatest single venture on the high seas in the history of the American Merchant Marine. It is a novel and trying experience, for, although we have run and are now running some pretty big ships in the trans-Atlantic passenger service, not one of them is comparable either in size or in complexity to the "Leviathan." There are critics who claim that only the older companies, with ample experience and a large trained staff to call upon, can place a ship on this route and run her successfully from the very day she enters upon active service. We all know the old saying "Give a dog a bad name," and if the "Leviathan" had started on her first voyage with a crew of between 1,200 and 1,500 unacquainted men, and with all other with their officers or with the ship, and difficulties had developed in the engine room, on deck, or in the service of the passengers, there would have been a crowd of "I told you so's" from the skeptics, and the prestige of this great ship would have suffered a blow from which it might never have recovered.

The situation is well understood by shipping men. The foreign services, particularly the British companies, have always made it a point to run trial trips, with a large number of guests, for the purpose of "shaking down" a new vessel, not merely as regards her engine room and crew, but also in the dining room, stateroom and social service. Extended trial trips of this character were taken by both the "Lusitania" and the "Mauretania."

The "Leviathan" is much more than just a big ship. She is a giant steam power plant, equal in capacity to the large generating stations which furnish power to drive the subways and elevated systems of this city. She is an electric light and power station, with a plant installed to light the interior of the ship, and to maintain in a large pumping station, whose turbines maintain an amount of water which would suffice for the needs of a city, and lastly she is a first-class hotel, matching in her luxurious accommodations and her capacity for guests the very finest of our far-famed American hotels. It would be the very height of folly to throw together this great aggregate of men and machinery and expect it to function smoothly without the proper tests and training. Hence it came about that just as the Government sent the "Leviathan" on a five-day trial trip after reconditioning for the transport of troops, so now it has subjected her to a similar five-day trial after her elaborate reconstruction and reconditioning as a first-class trans-Atlantic liner.

The "Leviathan," as you have said, is a great American venture. Into the work of reconditioning has been put all the experience of the past and many new features which, as we have shown in the article elsewhere in this issue, are designed to render her the most and most comfortable liner afloat. The men who have done this work, engineers, contractors, draftsmen and even the working men at the yards, have regarded their task as something in the nature of a sporting proposition, and we have reasons to know that hundreds of them have worked long hours of overtime without pay, believing that there was a chance to show that what we did 70 years ago, when the little ship "Great Republic" won out at Cowes, we can repeat with the "Leviathan" upon the trans-Atlantic course.

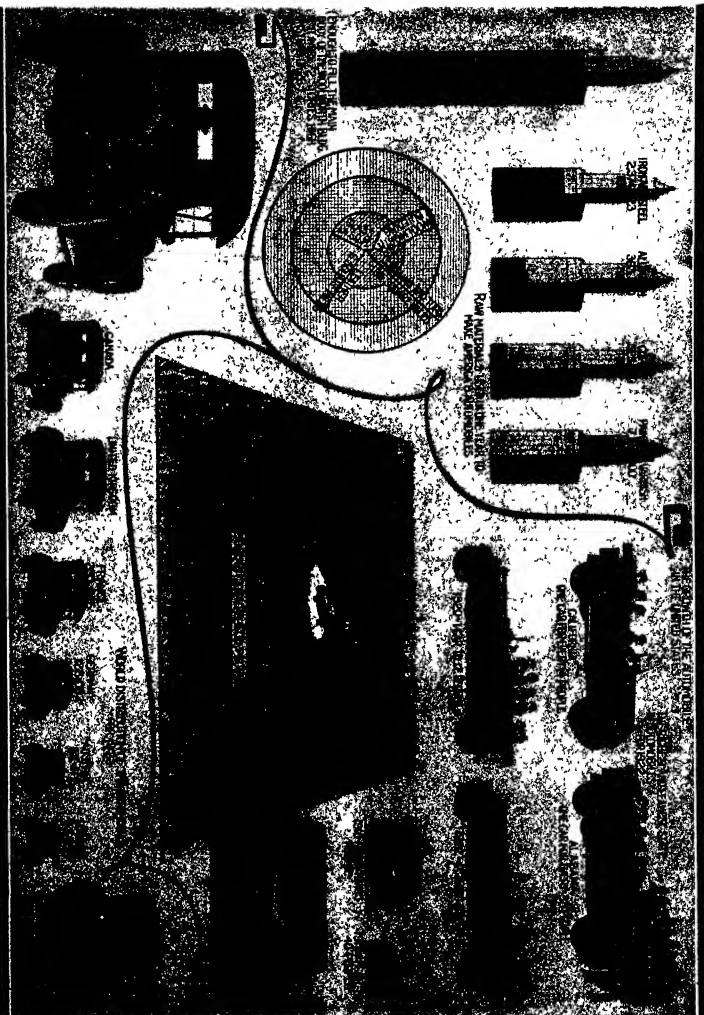
A GRAPHIC SHOWING OF AMERICAN AUTOMOBILE STATISTICS FOR 1906

The following table shows the number of automobiles registered in each State and Territory for the year 1906. The total number of automobiles registered in the United States for 1906 was 100,000.

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Summer Time and Radio

Recent Developments in Radio Broadcasting that Challenge Warm Weather Handicaps

By George V. Haskell

RADIO broadcasting is now on a full-time basis. Or to put it another way, this is a radio summer. Thousands upon thousands who became radio fans during the long winter months are now maintaining a keen interest in radio especially during vacation days. Radio receiving, sets are still well despite the thunderstorms and noisy static disturbances and the all round reduction in radio efficiency due to warm weather. And in the new shore home the mountains home or lodge the camp, the summer resort, the farm and elsewhere the radio receiving set especially in portable form is very much in evidence. Even the touring motorist is now carrying a portable radio receiving set tucked away among his luggage for an occasional bit of entertainment or for his daily news and stock reports and weather forecasts by the radio, or in the motor camp. No radio broadcasting, is it now in summer, a privilege as well as an indoor pastime of the winter season.

Radio communication is at its very best during the cold crisp winter nights. At such times there is a minimum of atmospheric disturbances or static as the noises of space are calmed. Even too the average receiving set reaches out to the remotest points in an astounding manner as compared with the very much curtailed range during warm weather. Winter time reception of speech or music is as clear as a crystal—hardly by a good deal than the usual telephone line. Indeed the crystalline atmosphere of winter is as transparent to radio waves as it is to the night when viewing distant objects.

But with the approach of warm weather the atmosphere is no longer as transparent as it has been during cold weather. It becomes it is said. It is too much of its transparency, receiving ranges are cut down radio telephone reception is blurred and distorted extraneous noises grow in number and in volume. Radio programs are not broken up in the most serious listening manner.

Again warm weather is outdoor weather. Therefore the radio receiving set has been a rather cumbersome installation calling for various pieces of bulky and delicate apparatus, particularly a bulky and useless storage battery which did not lend themselves to ready

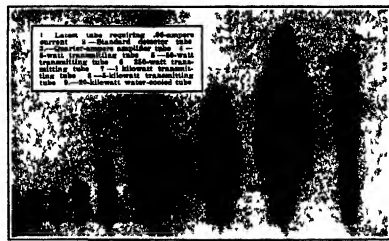
transportation. The consequence has been that radio has been left at home when the average American sought the outdoor life of summer time and vacation time. Again there has been a strong fear of lightning and the consequent fire hazard attending its connection with the usual radio antenna or aerial, with the result that many a radio receiver has been taken down and packed up and stored away with the first signs of warm weather.

It was so in the summer of 1922. The worst radio

to the summer ailments of radio. Today there are some eight hundred broadcasting stations in regular operation, blanketing every corner of this vast country, as compared with 160 or so during the summer of 1922. The consequence is that everywhere, anywhere, with any kind of set, is reasonably sure of nearly broadcasting service. No longer is it necessary to remove every effort to pick up a long-distance radio broadcasting program, together with all the static and other interfering noises which come along with weak signals. Broadcasting stations today are powerful and when they serve nearby receiving sets, their signals are sufficiently strong to compete with all noises of space except those produced by a local thunderstorm. So the burden of overcoming summer-time radio has been tackled by the broadcasters to a large extent, which is as it should be.

The logical starting point in tackling static is to produce powerful radio waves which can be intercepted by relatively insensitive receiving sets—that are fairly immune to most parasitic disturbances. If one is satisfied with the nearby radio broadcasting programs, there is no reason why radio should not be enjoyed to the full during the warmest weather. The long and high antenna or aerial of cool and cold weather is replaced by a much shorter and lower antenna, or what is still better practice the outdoor antenna is dispensed with entirely in favor of a short indoor antenna consisting of a single wire tucked behind the picture molding and measuring anywhere from 20 to 50 feet in length, or even a small loop consisting of four to eight turns on a wooden frame, measuring three feet to five feet high. The smaller antenna or the loop will not intercept as much energy as the large outdoor antenna, but allowing for the powerful signals of the nearby broadcaster, sufficient radio energy will be picked up to provide clear, clean cut radio entertainment. It may be necessary in some instances when static conditions are exceptionally bad to use our planes exclusively temporarily during away with the loud speaker.

As far as lightning is concerned there is little to fear now because it happens to have a radio receiving set. The possible dangers of lightning have been greatly exaggerated by the press, in many instances quite unconsciously at the very time the press was actually



Vacuum tube family, ranging from the tiny dry battery receiving tube to the glass transmitting tube.

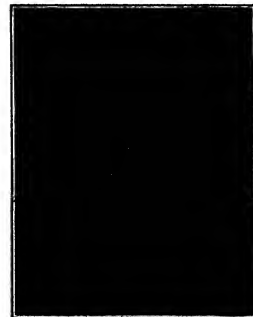
Industry encountered a serious slump with the approach of warm weather. The preceding spring and winter marked the real beginning of radio broadcasting. The radio industry had come into being with a rush and a plentiful volume of business was transacted within a few months. Stores were at their wits end to provide the necessary stocks of goods for the ever growing class of enthusiastic customers. It was a case of production not selling. Meanwhile the manufacturers were literally swamped with orders and only by the most strenuous efforts did they succeed finally in matching up their production with the public demand. The stores at last enabled to procure the necessary stocks of goods took on the job which they could carry in anticipation of a continued brisk trade.

Then with little if any warning, the bottom fell out of the radio business. The public stopped buying with the approach of warm weather. The stores could not move their goods. The manufacturers' little intense demand found many of their orders unexecuted and the large flow of quality production suddenly backing up in them. The natural sequel was a cut throat slashing of prices such as no other business has ever witnessed. In many unimagined quarters it was freely predicted that the radio industry was a passing craze and that the boom had been picked and would deflate in both legs in short order. But to the better informed this state of affairs was simply a marked slowing up of the radio industry during warm weather due to our lack of foresight on the part of engineers and business men alike to provide for the radio dog days of summer.

The decline in radio enthusiasm during the summer of 1922 may be attributed to four factors. Failure on the part of the radio industry, both from an engineering and business standpoint to meet summer-time conditions and to maintain radio interest; secondly, the prevailing fear of lightning; thirdly, interference from static and the general lowering of radio efficiency.

But hygienic are hygienic and the radio industry, during the prosperous fall, winter and spring seasons last year has had sufficient foresight, even during brief business months, to look forward to the coming warm weather and to provide for it. The result is that this summer finds us better prepared to do business at home and in vacation quarters, and it begins to look as though radio were at last promoted from a part time job to a full time one.

To begin with, considerable attention has been given



Typical portable receiving set making use of dry battery and radio-frequency amplification.



Insulation from a bellied antenna which can be readily extended down in collapsed form.

trying to receive radio beyond that there was no real danger if due precautions were taken.

With the several million receiving sets now in operation, there has been no increase in lightning damage. On the other hand, there is no way in which property protection, brought about by the proper grounding of an antenna, can be estimated, but it must be considerable. The mere fact that lightning rods are again being considered in localities subject to severe thunderstorms, should be taken as a recommendation for a radio receiving set with a high, long and properly grounded antenna. The requirements of the National Fire Protection Code, with modifications suggested by the National Board of Fire Underwriters, are simple and effective, and when once complied with there should be no further fear from lightning hazards.

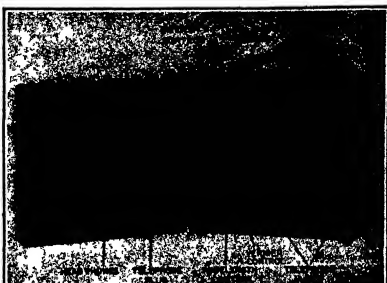
If a thunderstorm is raging in the immediate vicinity, one may as well bring the lightning arrester into play and lay the head "down" aside. Distinct reception of radio telephone communications is taboo when the angry elements of the clouds are in action, since a local thunderstorm is one of the three outstanding factors affecting radio audibility. Static frequency and static audibility are the other two disconcerting forces that may interrupt the reception of grand opera or break the continuity of market reports by radio telephone.

A series of experiments, cooperatively engineered by the Weather Bureau of the United States Department of Agriculture, and the Nebraska Wesleyan University, have been productive of conclusions that tend to reduce the question: "Can radio messages be heard in a thunderstorm?" Undoubtedly, if we are to accept the results of these scientific tests, the ability of a radio telephone receiving set to deliver speech or music in distinctly audible tones is thus impaired. In fact, the investigators lay the subject of the relationship of weather conditions to radio audibility mostly three outstanding factors as affecting the clearness of radio reception. These, in the order named by M. P. Brule of the Nebraska Wesleyan University, are (1) static frequency, (2) awareness of thunderstorm area to receiving station, (3) static audibility. However, the atmospheric conditions at the radio transmitting point do not exert an influence on the audibility of messages at a distant point. For instance, a local thunderstorm in progress in Washington during the transmission of a radio communication from the powerful radio station of the United States Navy Department, would not mar the clear reception of the message in New York City.

The fluctuations of the barometer—or the instrument for revealing the weight or pressure of the atmosphere—did not appear to influence the audibility of the radio signals. The absence of relationship between barometric pressure and the state of hearing of radio communication is cause for skepticism on the part of the Weather Bureau of the United States Department of Agriculture, that radio instruments may be employed as a direct means of forecasting weather conditions. Attaching some credence to the theory already advanced to the effect that the use of radio direction finders and the audibility of static or atmospheric disturbances in the radio receiving apparatus are agencies for forecasting the approach of storms, meteorologists cannot but find the essential factors for forecasting are still lacking. However, the Bureau of Aeronautics of the United States Navy Department, in experiments in the Florida, and other parts of years, conducted at Pensacola, Florida, and

Hampton Roads, Virginia, claims that radio instruments have been effectively employed as weather vanes in forecasting the approach of hurricanes or violent thunderstorms that might prove disastrous to aviators.

But that mooted question as to the results of the tests of the Weather Bureau and the Nebraska Wesleyan University have evolved the suggestion that weather forecast maps can be advantageously employed by radio transmitting stations to determine the handicap or favorable conditions in the environs of the various radio receiving stations. In these particular scientific observations it was determined that a thunderstorm raging in proximity to the radio telegraph and telephone transmitting station of the Navy Department at Radio or Arlington, Virginia, exercised no effect on the reception of the communications by the Nebraska Wesleyan University, at University Pines, Nebraska. A radio telephone message originating at this station during a local thunderstorm was heard distinctly at a distant point where no violent atmospheric disturbance was in progress. The barometer readings and the nature of the nearest thunderstorm area were determined to use of a weather



Another form of portable receiving apparatus, which will receive with a few feet of wire for the antenna

static even when lightning flashes are plainly visible to the eye. The audibility of a signal required to offset quite completely the normal static interference is less than 200 and local stations will be found to produce at least 500 times audibility with the average two-stage receiver.

Under the old scheme of things—and anything over a year old is apt to be termed "old" in such a young and progressive industry as radio—the equipment used for receiving over fairly long distances was quite cumbersome. The vacuum tubes—these little lamps which are the heart and the soul and the brain of the usual radio receiving set—have been steadily developed. The first vacuum tubes required in broadcasting reception required a six-volt potential and somewhat over one ampere of current for each tube. The heavy current drain even when using a single tube necessitated the use of a storage battery for the filament energy.

In due course these first vacuum tubes gave way to others which made use of special coated filaments instead of the plain tungsten wire, and which required somewhat less than one-quarter ampere for each tube. One of these tubes operates on a single standard dry cell, and therefore made itself to use in a portable receiving set.

The latest type of economical vacuum tube requires somewhere between 3 and 4 volts and a current consumption of 60 milliamperes—or a trifling more than one-twentieth ampere. A single tube of this kind will operate on three cells of flashlight battery, and three tubes of this kind can be operated for a long period of time on three standard dry cells.

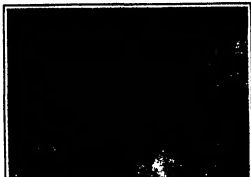
Due to these economical tubes, it is now possible to produce a receiving set which easily dispense with the former cumbersome storage battery and which, through the use of several tubes for amplification of signals, is of such extreme sensitiveness as to operate on any kind of a temporary antenna, or even a small loop. There are now being produced several types of portable sets which are considerably smaller than a small suitcase. These sets are self-contained, with the filament and so-called "B" or plate battery neatly mounted in the case.

The portable sets with their dry cell have taken radio quite outside the home circle since reception demands. This summer the radio enthusiast has no excuse for not taking his radio set with him on his vacation trip, especially in view of the redoubtable efforts of this broadcaster to provide better entertainment features, more sporting comment, better news service, and so on. The new wave in portable sets is now in force, and has contributed materially to the betterment of broadcasting.

A German Motorist's "R. O. S."

DIFFER slump in German currency necessitates the pay of many thousands of marks for motor cars. One would be pardoned for having hopes of getting over this financial difficulty by the assistance of the British Automobile Association, which has received the following letter:

"I beg you, pardon, Sir, if I come to you with a bag. I have very interest to the Motor sport, and that I have not enough money to buy a motorcar. I would you beg to send me some I. If you will not I beg you to ask your colleagues that the give me some I. I have one good motorcar in my garage, but I would be thankful to you if you despatch some I as early as it goes."



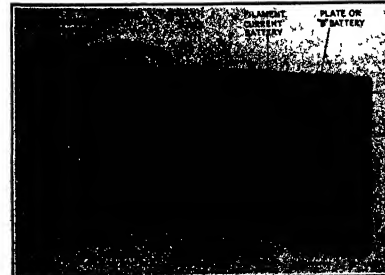
Receiving set of the console cabinet type, with self-contained dry batteries

map of the United States for the corresponding twenty-four hours.

All of which leads down to the conclusion that thunderstorms do not interfere with radio reception in any marked degree except when they are in the immediate vicinity of the receiving station. Static does not hinder radio telephone reception very appreciably. In this respect telephony has one great advantage over radio telegraphy. For instance, speech can be carried on after a fashion in extremely poor static assemblies. The ease in understanding speech under such circumstances is due to our lifelong experience. Then, too, there is what may be termed "amplification of content." By this is meant the ability of the average listener to fill in lost words which make sense to the entire sentence.

Since static and signal are amplified alike, it would seem advisable to suggest low frequent use of the loudspeaker in favor of head telephones, an already suggested, when intense static exists. Vacuum tube amplification, especially a d.c., should be reduced to a minimal sum consistent with signal strength.

Bolden, if even, is a program from local stations seriously interrupted by



Interior view of portable set shown in upper right-hand illustration



This locomotive, the heaviest in existence, with a tractive effort of 175,000 pounds, is one of the many powerful steam units which are to be replaced by electric locomotives with a tractive effort of 277,500 pounds.

Another Forward Step in Electrification

How the Virginian Railway will Replace Steam with Electricity for Hauling Heavy Trains

WHEN the late Henry H. Rogers decided to build the Virginian Railway, his plan was to build a railroad of the highest standard in the United States, one that would be the envy of the West. Virginia money people, it is said, thought his judgment had begun to slip. He was of advice to build a line from the results of his efforts, and few people believed that the Donkeywater Railroad—of Virginia as it is called—would ever become a success. But events showed that Mr. Rogers' intuition was not in vain. Within a very few years after operations were started in 1900 the Virginian Railway began to make money and it soon began to make profits for its shareholders. It is the envy of almost every railroad in America. For example, the ratio of its operating expenses to its earnings in 1922 was 65.44 whereas this same ratio for two other roads running through the same district were respectively 75.27 and 79.2.

There are three chief reasons for the success of this road. In the first place it obtains continually increasing traffic from the Potomac-River fields through which it runs. Secondly, it was constructed so as to keep operating expenses at a minimum with the least trucks and the smallest number of curves that the character of the country permits. Finally it operates its line in accordance with a system known as mass transportation, which is undoubtedly the most economical method under the existing conditions.

By mass transportation is meant the handling of the traffic by the largest possible trains instead of a much greater number of small trains. In accordance with this policy the Virginian operates the heaviest trains of any railroad in the world built with the most powerful steam locomotives. It handles and has had special 120-ton coal cars on a double-track air track designed to suit its special service.

With this equipment seven million tons of coal can be hauled annually from the mines to the sea at Nor-

folk in a unit recently this capacity was ample. But now the production of the line served by the railway has reached this figure and unless the traffic capacity of the railway can be increased in some manner a definite limit has been set to the output of this important district.

The trouble lies at the grade over the Allegheny

with the use of steam locomotives of any known type. Electrification, however, provides a way out. By using a total of 40,000 horsepower of electric locomotives per train (which is by no means the present maximum possible limit), trains of 8000 tons can be taken up the grades at 14 miles per hour. This practically doubles the present capacity of these tracks and still provides a considerable margin for future expansion. In addition, since electric locomotives require much less care than steam locomotives, are available for a far greater proportion of each 24 hours, and consume power more efficiently, very material operating economies could be obtained by their use. For these reasons the management of the Virginian decided to electrify the mountain section of the road, where the difficulty is centered.

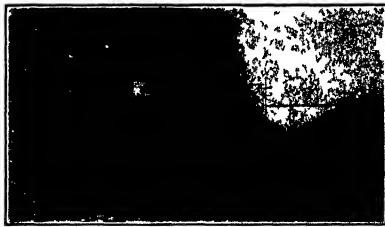
The system adopted according to Mr. H. L. McCallum, railway engineering of the company that is supplying the electrical equipment is the alternating-current, single-phase system with an overhead trolley similar to that used with such success on the Norfolk and Western, New York, New Haven & Hartford, the Pennsylvania Railroad at Philadelphia, the Grand Trunk, the Boston & Maine Railroad and the Erie Railroad, the Spokane and Inland Railway and the Chicago Lake Shore and South Shore Railroad.

Each locomotive will have the following characteristics:

Total weight approximate	900 tons
Weight on drivers	450 tons
Traction continuous	136,000 pounds
Traction maximum	277,500 pounds
Speed	14 or 28 M.P.H.
Horsepower continuous at 14 M.P.H.	33,115 H.P.
Horsepower continuous at 28 M.P.H.	16,557 H.P.
Diameter of drivers	58 inches
Length over coupling knuckles	145 feet 6 inches

The locomotive will receive current from a 24,000-volt trolley wire through pantograph collectors; this current will be stepped down by transformers to the locomotive itself to a low voltage and delivered to the

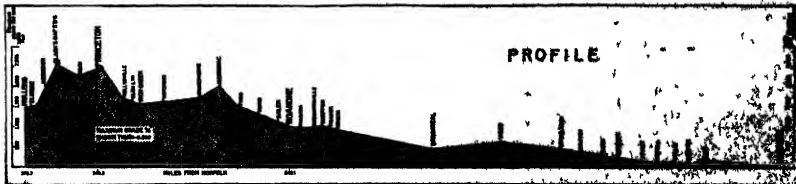
(Continued on page 121)



This electric locomotive will haul 8000 tons up the mountain grades at 14 miles per hour as compared with steam haulage of 5000 tons at 7 miles per hour.

Mountain. Elsewhere the coal moves freely enough, but for crossing these mountains 8000-ton trains must be cut down to 5000 tons and even when such of these smaller trains is handled by three-compartment articulated Mallet locomotives speeds exceeding seven miles an hour cannot be secured.

Two things can be done to remedy this situation. More trucks can be built or greater power can be applied per train so as to move the trains up the grades at higher speeds. The first alternative involves considerable expense while the second is impracticable with steam power for the simple reason that the 8000-horsepower now being applied to each train represents about the maximum power that can be obtained



Profile over the Allegheny Mountains of the Virginian Railway, which is about to be electrified.

When Light Recording and Reproducing Sounds by

By Lee

Speaks

Means of Light Intensities

DeForest, Ph. D.

ATTENTION was focused on the field of talking motion pictures wholly disproportionate to the according in 1918. Perhaps the one consideration which more than any other prompted us to enter this field was my desire personally to develop a new and useful application of the audion amplifier—one which I could expect to develop largely by my own efforts as distinguished from the application of long distance telephony where obviously the intensive efforts of large corps of engineers lacked in a gigantic business organization, were indispensable.

Another motive was my desire to see a plus magnetic device which would be free of many of the inherent short comings of the disc machine notably the short length of record, the necessity for frequent changing of needles and the belief that by means of a pencil of light instead of a steel needle it might be possible completely to escape from the surface scratch which has always been inseparable from the existing type of phonograph.

Early in the spring of 1919 I filed patent applications on the methods which I believed would accomplish the above-mentioned conditions and began actual research on the various means which might be successfully employed. At that time I figured that the work involved should require at most two years of period one-half as long as that which has actually been demanded. The work has been almost uninterrupted and of the most exacting and discouraging nature. Literally hundreds of experiments have been made and thousands of feet of film have been photographed only to be thrown away.

The Phonofilm as its name implies, is the combination on the same film of picture with voice or music photographically recorded on standard cinematograph film is used. The sound record occupies a very narrow strip of the film about three thirty seconds wide in the margin and does not materially reduce the width of the picture.

An especially designed gas-filled lamp called the Phonon light, is directed on the moving picture camera a short distance away from the usual objective lens. The light from this Phonon tube passes through an extremely narrow slit and falls directly upon one margin of the film. This margin is screened from the picture itself so that only the light from the Phonon falls upon it. The film is driven continuously with an even speed in front of this narrow slit but with the usual intermittent step by step motion in front of the picture aperture.

Now the light in the Phonon tube is generated by the electric current which is passing through the gas enclosed therein. The intensity of the light depends on the intensity of the electric current. Therefore if a powerful telephonic current is passed through the Phonon the light emitted varies exactly in accordance with the strength of the telephonic current at any instant. This light therefore, fluctuates in brightness hundreds of times in a single second in perfect rhythm with the tele-



Dr. Lee DeForest, the well-known inventor of the vacuum tube, with his latest invention, the phonofilm "talking picture" camera

phonic current pulses, and varies in strength with the current.

This telephonic current originates in the first place from the special microphone transmitter which is quite unlike the ordinary telephonic microphone, but serving the same general purpose. This transmitter picks up the sound waves at distances of five to fifteen feet from the source of sound, transforming these sound waves into very weak telephonic currents. The audion amplifier is then used to amplify these weak currents 100,000 times to bring them up to sufficient strength to influence the Phonon lamp in the camera. Without the audion amplifier the entire arrangement would be utterly impractical because of the weakness of the voice currents.

Thus we have three transformations—first, sound waves into electric telephonic currents, then the amplification of these currents into light waves, and the registering of these light waves through the narrow slit upon the photographic film.

The negative film carrying picture and sound record is now developed in the usual manner but using a special developer to bring out the details of the sound record. Positive prints are made through a special printer to give the necessary light values for picture and sound record. This positive print is then run through the moving picture projector machine. This is a standard projector machine such as is found in any moving picture theater. A small attachment is added to the projector which in no way interferes with its ordinary use. This attachment encloses a small house-shaped lamp and a highly sensitive photo-electric cell, the latter being the invention of T. W. Owsen. Between the lamp and the photo-electric cell passes the film as it travels through the projector machine. The light from this house-shaped lamp is concentrated upon a tiny slit similar to that above described in the motion picture camera. This light then passes through the sound record which has been photographed on the film, and on to the chamber containing the photo-electric cell. The passage of this sound record across this narrow slit, therefore, controls the intensity of the light falling upon the sensitive cell.

The photo-electric cell has this peculiar property—its electrical resistance at any instant is determined by the

amount of light falling upon the cell. Therefore, as the film travels across the slit and the light falling upon it varies in intensity from one hundred or thousands of times per second the electrical resistance of the cell is varied in strict accordance therewith.

Connected to this photo-electric cell is a small battery for supplying current, which current is therefore controlled by the light falling upon the cell and thereby made exactly to reproduce the original telephonic current from the transmitter when the sound picture was first recorded. This new telephonic current, however, is extremely weak, and must be amplified, again through a series of especially designed audion amplifiers, until it is increased in power hundreds of thousands of times. This powerful telephonic current then is passed through specially designed loud reproducers which are located behind or alongside of the moving picture screen upon which the picture itself is being thrown from the projector. In this way the reproduced sound appears to come from the voice of the speaker or the musical instrument whose picture is being thrown upon the screen.

By the phonofilm process the problem of synchronism is obviously completely solved. This is because the position and the object are always together on the same film. The only problem involved in the phonofilm is it is only necessary to insert a new piece equivalent in length to the part cut away, so that the audience is not aware of the break. If the film breaks it is only necessary to insert a new piece equivalent in length to the part cut away, so that the audience is not aware of the break.

"Throughout my work I have had in mind the making of the process thoroughly practical and commercial. Only standard film is used and the reproducing attachment is designed for attaching to any standard projector.

Spherical Aberration in Thin Lenses

THE images formed by lenses are imperfect and it is the task of the lens designer to compute lens systems in which the faults in the images shall interfere as little as possible with the uses for which the lens is designed. The requirements for a telescope objective are different from those for a microscope objective while those for a camera lens are still different and vary according to the particular type of work which it is desired to carry out with the lens. Lens designing is really an engineering proposition in which known principles of physics are applied to the solution of a definite problem in construction.

Scientific Paper No. 461 of the Bureau of Standards is a paper on "Spherical Aberration in Thin Lenses," for sale by the Superintendent of Documents Government Printing Office, Washington, D. C., at 10 cents a copy, is a contribution to the meager stock of on the subject of construction of lenses. It presents the data with reference to spherical aberration in a wide range of shapes of lenses for each diameter of aperture. These data have been calculated from the optical constants of the materials used in the construction of the lenses, and are not in optical design.

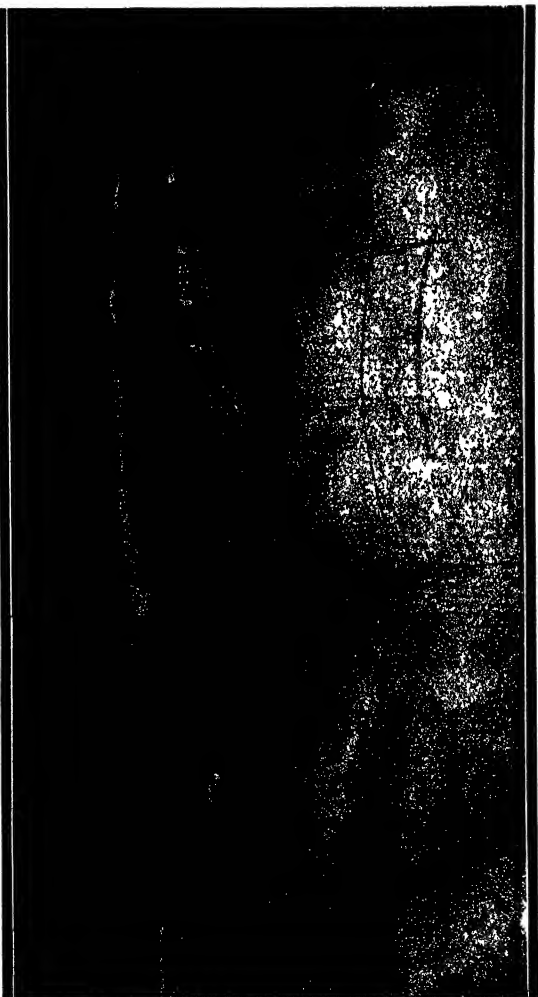
These data have been calculated from the optical constants of the materials used in the construction of the lenses, and are not in optical design.

Instructions are given in this publication for calculating without graphical labor the curves for a lens system and for determining the positions of the principal planes. The results are represented in the form of a series of curves and tables. The curves are a short description of the aberrations and positions of the principal planes of the lens system. The tables are a short description of the aberrations and positions of the principal planes of the lens system. The tables are a short description of the aberrations and positions of the principal planes of the lens system.

Phonofilm actual sound record at right

Sound waves record of records, the phonofilm strip being carried across them.

Length, 566 feet. Beam, 35 feet. Draft, 13½ feet. Displacement, 1998 tons. Heavy guns, 56,000. Maximum speed, 15½ knots. Battery, twelve 6-inch guns



THE naval program of 1916 included provision for the construction of 10 battlecruisers, of which 7000-ton displacement with 55 knots speed. They were to be built and armed in order to meet the requirements of the fleet. The program was to be completed by the construction of 10 more ships, of which 10,000-ton displacement with 55 knots speed. The program was to be completed by the construction of 10 more ships, of which 10,000-ton displacement with 55 knots speed. The program was to be completed by the construction of 10 more ships, of which 10,000-ton displacement with 55 knots speed.

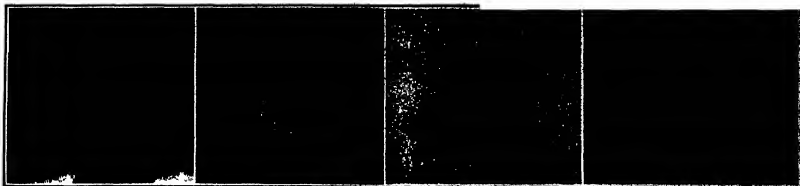
been described as a "cruiser-destroyer." A major feature of the ship is its speed, which is 15½ knots. It is a remarkable feat, as it first designed the ship was to be a "cruiser-destroyer." A major feature of the ship is its speed, which is 15½ knots. It is a remarkable feat, as it first designed the ship was to be a "cruiser-destroyer." A major feature of the ship is its speed, which is 15½ knots.

NEW UNITED STATES SCOUT CRUISER "RICHTON"—FASHER OF ITS TYPE

which are grouped forward of the forward gun turret and aft of the aft gun turret. The ship is armed with 12 6-inch guns, 10 5-inch guns, and 10 3-inch guns. The ship is also equipped with 10 100-mm guns, 10 50-mm guns, and 10 30-mm guns. The ship is also equipped with 10 100-mm guns, 10 50-mm guns, and 10 30-mm guns.

Battery, twelve 6-inch guns

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Some of the insects that live by preying upon other insects, and the fashion in which they get their food

Insect-Eating Insects

Some Glimpses of the Eternal Struggle for Survival

By Dr. E. Boda

LIFE, which is a continual battle for existence, is fought without regard to rules. The weeds, whose seeds are carried by the drift winds to the flower beds, fight against the cultivated flowers. They struggle toward the light, and attempt to suppress the desirable flowering plants. Everywhere in this strife of life, the eggs, the personal "I," finds expression. The stronger often kills the victim of the weaker through thousands of artifices and ingenious devices, since mother nature is by no means embarrassed in finding new means and ways to arrive at its desired goal. In this respect also is the most prolific inventor, she tries ways which appear harmless enough, but the end is always the same, perpetuation of the species.

The above caterpillar which suddenly eats one leaf after the other, can hardly be distinguished from the surrounding green of the foliage. Suddenly it is frightened from its meal by the appearance of a thread-waisted wasp. The latter flies about it a few times, until it finally alights near by. The caterpillar senses danger, and lifts the anterior part of its body to a position of defense. Nervously the wasp runs about the leaf, the feeders vibrate, the slender abdomen is jerked up and down. Suddenly it lifts itself, hurls itself upon the caterpillar, and grasps it tightly by the neck with its strong mandibles. The poison sting is first placed under the neck of the defenseless larva, and a second sting is placed near the middle of its body, and the caterpillar and the wasp fall to the ground. The caterpillar is not killed by these stings, but it is paralyzed so that it cannot move about freely of its own accord.

The parasitoid is then carried by the wasp to some previously dug cave or cavity, and an egg is then deposited on it. When the larva hatches from the egg, it enters its involuntary host at once. Here the fatty parts of the caterpillar are eaten, and when the larva is fully grown and is about to pupate, the vital organs are eaten, and the caterpillar dies.

Other military wasps build nests of clay for their young. These are usually found under nests of bees. Often more than one cell is joined together, and each one is filled with a paralyzed spider, fly, etc., which are eaten alive by the larva. Through the parasitoid, the wasp provides its larva with a constant supply of fresh

meat sufficient to last until they are ready to pupate. The ichneumon flies (wasps) lay their eggs directly into the body of their prey, and often the eggs of other insects are provided with eggs of these wasps. Nearly every species of butterfly larva is preyed upon by certain special species of ichneumon flies. The large species lay only one egg, of the smaller and smallest species, many hundreds of eggs are often deposited in one caterpillar.

Species of all insect orders fall victims to the rapacity of the ichneumon flies. The *Brassicella* infest plant hods.



The ground beetle actually overhauls its victim by the use of "shank's mare"

They deposit an egg in the plant hods, and after a short while its abdomen will have become greatly distended, and it now forms nothing more than a cavity for the wasp which will soon emerge.

The ground beetles, also, are mighty hunters, and they are of considerable economic importance as destroyers of insect pests. As exceptionally rapid runners, they chase and catch smaller beetles, and their murderous propensities lead them to the destruction of snails, cutworms, and others. They are liveliest in the hours of darkness, and when dark falls they begin their insect hunt. Some burrow all day long, while others remain half hidden on the ground between the fallen leaves, waiting for their prey.

The tiny lady-betters (Coccinellæ) and, their larvæ

live almost entirely upon plant lice and scale insects, and therefore deserve the most extensive protection. But besides these pests, others are also destroyed, the eggs of the potato-beetle being especially relished.

Beneficial, at least to some extent, are the robber-flies (Asilids) with the families *Dasyllæ*, *Leptogasteræ*, *Brexiæ*, and *Asilina*. The species of *Dasyllæ* resemble the harmless bumble-bees, and this helps them to come close to their unsuspecting prey. On the other hand, it may also protect them from other insect-eating animals. In general the robber-flies are strong and dart quickly through the air. Like birds of prey they hurt themselves upon other insects, grasping them by the wing with their front legs, and carrying them to some convenient spot where they can suck out the vital fluid in peace. The beaks of many of these robber-flies are so strong that they can easily penetrate the skin of man, but they do not attack warm-blooded animals. Their prey consists of all kinds of insects; even the larvæ of butterflies are sometimes, though seldom, taken.

True dragons of the air are the various species of dragon-flies. Like birds, they suddenly halt in mid air, hover quietly in the same place, turn quickly about, suddenly shoot vertically in the air, and dart away as if harried from a gun, so rapid is their motion. In this, their restless flight, all animals which they can conquer, are caught. From out of the dancing mosquito swarms over ponds and streams, many an intruder is suddenly carried away and eaten. The bee flies (true flies) and their allies, which visit the flowers, fall their prey. The fluttering butterfly is crushed by the cruel mandibles, and the clumsy, heavily armored, beetle is not safe from attack.

All the smaller insects are caught with the mandibles, the larger prey being seized and held by the feet. These are often torn to pieces while the dragon-flies are still in flight, or it carries its prey to some resting place where it is unharmed at leisure.

The life of all insects in all their stages of development, with the exception of the resting pupa stage, is to eat. These animals can eat an inconceivable quantity of plant material in their short existence, which can be summed up in four words: eating and being eaten. The profane insect life is continually being destroyed in order to make life possible for a small minority.



The soldier fly and its prey

Dragon fly on its prey

Three more of the most rapacious of the insects that help to keep down the numbers of the pests

Immunizing Cabbage by Natural Selection

How Nature's Standard Biological Process Is Adopted and Speeded Up by Man

By Robert G. Sharrett

IF YOU were considered the cabbage as a factor in the American diet? Have you any idea how prime a part it plays in our actual crops? If you have not, the following is the editorial note attached to give you some idea of what the ruin of this crop would mean to American agriculture.

Just this twenty years ago the cabbage "rot" of Wisconsin was widely ravaged by a disease known to agriculturists as "cabbage yellows" and the loss caused from 10 to 20 per cent in fields containing of highly-fertile soils normally peculiarly suited to cabbage culture. The farmers and the State authorities naturally became much concerned, and steps were taken under the leadership of Dr. L. B. Jones of the University of Wisconsin to determine the cause of this harmful affliction. What has since followed is a fine example of scientific research applied to a relatively new problem.

When a cabbage is afflicted with the yellows in its more aggressive form, the vegetable loses vigor, the leaves shrivel, its foliage assumes a yellow, wilted look, and frequently dies long before reaching the heading stage. The prevailing cause of the disease is a soil fungus known to the technician as *Pseudomonas glutinis*, and a soil so infected is termed "cabbage sick." Once the fungus has been introduced into the soil, it persists indefinitely, and we are told that ordinary crop rotations are of little avail in controlling the disease or in rooting it out. Other vegetables may be planted for a number of years and grow abundantly, and yet when cabbages are tried again the harmful fungus does its destructive work.

In 1910, the plant pathologist at the university's agricultural station began investigations with a view to having for their goal the evolution of control measures. These included diverse methods of treating seed, seedlings, and soil, and the use of various chemical disinfectants and fertilizers, but without any success.

In 1910, the plant pathologist at the university's agricultural station began investigations with a view to having for their goal the evolution of control measures. These included diverse methods of treating seed, seedlings, and soil, and the use of various chemical disinfectants and fertilizers, but without any success.

The conclusion of this procedure was the selection of the most resistant strains of cabbage. But the task was by no means confined to propagating just a cabbage which would grow in infected soil and head despite the presence of the muzzling fungus; the pathologist had to effect the evolution of plants of sufficient vigor to permit normal heading in uninfected soil, and to permit the necessary support and sustenance to the growing plant. This led, first, to the selection of the most resistant strains, and then to the selection of the most vigorous strains. The work was done by Dr. L. B. Jones, who is now the director of the Wisconsin Agricultural Experiment Station, and the results were published in the *Journal of the American Society for the Improvement of the Cabbage*.

These results were made with the Wisconsin "rot" and the "cabbage yellows" strains—both of which are now the most common in the average field. The average field is now free of the "rot" and the "cabbage yellows" and the plants are healthy and vigorous. The results of this work are now being used by the Wisconsin Agricultural Experiment Station to select the most resistant strains of cabbage for the future.

emphasized further the good work of Dr. Jones and his collaborators. That is to say, there was an average of only 6 per cent of yellows among the resistant or Wisconsin Hollander wheats about 80 per cent of the commercial strains suffered seriously.

A warm soil encourages the virulence of *Pseudomonas*. The summer of 1915 was a hot and dry one, and during that period the relative immunity of the Wisconsin Hollander cabbage was put to a very severe test. Then, even the most resistant of this strain showed some indications of infection. In short, an average of 70 per cent of all of the Wisconsin Hollanders was affected; but as a rule the plants were not seriously diseased, and 80 per cent of the crop lived through the season. The non-resistant "controls" or commercial Hollanders were, without exception, attacked by the yellows, and only one per cent were still alive at harvest time. Today, a strain of the Wisconsin Hollander has been brought into the market, and the power of retaining *Pseudomonas* to a marked degree but it possesses certain desired physical characteristics.

The new strain reaches maturity earlier than the original stock. This strain has descended from a single head selected six years ago.

A similar procedure has been pursued in developing cabbages of other types so that they would be capable of withstanding or resisting the yellows even when grown on sick soil. Dr. Jones and his collaborators have lately reported that "these resistant strains have proved resistant as far as tested in other

the agricultural experiment station of the University of Wisconsin has, therefore, a wide field of application. The specific varieties developed in Wisconsin would presumably not be best suited for growth elsewhere; but the Wisconsin seed can be used in any region where the development of varieties suited to local conditions.

The Loudest Voiced Bird

WHAT is said to be the loudest voiced bird in the world is the bell bird, which is found in both South America and Africa. The naturalist, Waterhouse, says of this bird, which is also called the Campygnus, "It sings in loud and clear like the note of a bell and is audible at a distance of five kilometers. No song or sound of any other feathered foot dweller sooms so much wonder as the 'tolling' of the Campygnus. A single stroke of the bell is heard and those notes follow each other at intervals of about a minute."

The bell bird is pure white in color and about the size of an ordinary pigeon. Its head is adorned (or disadorned) by a singular yellow excrescence, which is lifted for a distance about seven centimeters, while the bird sings. It is this movable yellow structure which is connected with the roof of the mouth which provides the resonance which enables the bird to produce such a loud and clear bell-like note. Every one who hears its first note is amazed for the first time. It must proceed from some singular mechanism in the campygnus. It is a curious fact that the bird utters its song only when other voices are silent.

Geography and Intelligence

IN a recent address before the Section of Geography of the British Association for the Advancement of Science, Dr. Martin Newbigin discussed the subject of Human Geography. First Principles and Some Applications. Geographers are concerned with the study of the distribution of the human species; that there is a definite human geography, but little attention has been given to the problem as to the human species. The human species to environmental conditions differs from that of animals. Human man once ran to a number of species or even of genera—it is obvious that there was once a time when there was no distinctively human response, when adaptation led to specific differentiation, just as it does among animals. But since that time man has been a single species, it is clear that this time has passed. His passing appears to be associated with the fact that growing intelligence meant that the barriers of distribution which limit the movements of animals ceased to function.

Otherwise, this is its turn might have meant that human evolution had stopped, that man had ceased to be adapted to any particular habitat because fitted for all, were it not that the factors of fixation and isolation, so important in the case of the lower organisms, began to act in a new way. At the same time, however, communities became fixed to particular areas, and if the isolation was sufficient to ensure the necessary continuity and protection of the community, a communal as distinct from any individual adaptation appeared. The second part of Dr. Newbigin's address dealt with applications of the theory of human evolution to the chief field of civilization in Europe and the adjacent lands. Thus the causes which promoted the origin, growth, and development of the human race, and the culture of the great river valleys, of the Mediterranean seaboard, and of the forest belt of Western Europe were considered, and the difficulties of the present in establishing stable communities in the steppe lands of Eastern Europe discussed briefly.

FOR 1920, some 104,850 acres in the United States were planted in cabbage, and 940,525 tons of the vegetable were harvested. At average prices for the year, the value of this crop was \$75,000,000. The importance of the cabbage-growing industry is made clear when it is remembered that there are sections in which this constitutes the principal cash crop; and there are associated industries that are well contented upon a good cabbage harvest. Such is alleged to be the case in Wisconsin, and it is upon a situation that arose there, and the methods applied for dealing with it, that Mr. Sharrett writes here.—THE EDITOR.

The kind of cabbage crop that can be raised when the plants are able to resist an attack of "yellows."

Our experience gives us confidence that through further selection resistant strains suited to any localized conditions could be secured. It is our belief, therefore, that the cabbage industry can be permanently maintained in any portion of the country, insofar as the *Pseudomonas* or yellows disease is a limiting factor, through the selection of disease-resistant strains.

However, there seems a natural tendency on the part of cabbage of this sort to revert to the original type unless it is constantly obtained by selection from plants grown on soil impregnated with the troublesome fungus. In other words, the seed for healthy and vigorous plants should be taken from plants grown on soil impregnated with the troublesome fungus. By this method, so it seems, it will be possible to maintain the standards as patiently raised after more than a decade of investigation; and thus seed may be perpetually produced on any desired soil.

Besides Wisconsin, cabbage growing is carried on extensively in Iowa, Illinois, Indiana, Ohio, Pennsylvania, Maryland, New Jersey, and New York (the portions of New York) and the yellows have threatened to do much harm in all of these regions. The work of

Diamonds from Guiana

How the Precious Sparklers are Recovered from the Gravel

By Frank Munro



Bearing the redness gravel, dumped from the sieve, for diamonds.

THIS ROMANACE of the diamond-facinating but not alone to the devotees of luxury and splendor, but also to the serious and practical men of science and even to workaday folk—has having some interesting and illuminating chapters added to it by William J. Le Varre, an American mineralogist and explorer. He has been down near the equator, in British Guiana—abundant in its jungle haze, has lighted up that country with the sparkle of its own pen, and has given the hope of wealth, to those, at least, who will intelligently work for it, and take the dare of mosquitoes, malaria and a generally trying climate.

Even the primitive methods of the unskilled natives are yielding large returns, but Mr. Le Varre feels that with the introduction of modern ideas and machinery a new El Dorado will be revealed. The promise and potency is in his bringing back to New York, some time ago, a cluster of diamonds of 100 carats, recently returned with one of 500 carats, also the largest single stone, it is claimed, ever found on this continent, the "Korupung," of more than 80 carats. Indeed lately, it may be said he has gathered specimens of birds and animals for the Smithsonian Institution.

The new region of mineral wealth lies along the Mazaruni River and its tributaries, and is in the jungle about 140 miles from Georgetown, the capital of British Guiana. It has been well scouted by gangs of natives and half-breeds, who have received the name of "pork knockers," from the fact that their ration consists largely of pig, and they literally beat about the bush. Civilization has laid a very gentle hand upon the people up to the present. Now, apparently, it is about to subvert them with the crackle and crash of the steam shovel.

Despite industrial deficiencies, these pork knockers have for some years been shipping small lots of diamonds to England. The men go into the bush in groups or alone, securing the gravel from the shallow creek beds, or perhaps digging one or two feet into the banks. A happy-go-lucky crowd are they, of Dutch and Indian or Negro lineage. They gather at Bartica, the nearest point of civilization, and wait for a prospecting party that may require extra paddlers. Sometimes they "conquer" with a simple boat going to the trading posts in the mining districts. The trip takes several weeks, and is "worked out" by the voyage. On leaving the craft they receive a bonus in the shape of work supply of pig, rice, salt fish, etc.

The native prospecting usually begins his work in a shallow creek bed. The implements consist of an axe, shovel, pick, bucket and a sieve to separate the diamonds from the gravel.

"A party I once charged upon," says Mr. Le Varre, "was illustrative of the average group and method one

might see in the bush. A negro (giant in size and clad only in a loin cloth) stood knee-deep in the creek, and with a long-handled shovel filled a bucket with small gravel. The boy who held the bucket carried it to an old man, who did the 'scientific' part of the job, that is, the digging of the shallow hole in the round sieve. Diamond production depends largely upon the sifter. If he is careful and knows his work, there will be no loss.

"The old man was astride a pool about three feet wide and two feet deep. By a series of calculated motions he attempted to form a centrifugal force which would serve to cause the heaviest material in the bottom of the sieve, and as diamonds are the heaviest of the pebbles, they naturally are the first to respond to the movement. Where diamonds are found there are likely to be also tin, carbon and pulsat, mixed with quartz. These minerals are heaviest, next to diamonds, and are therefore also sent to the bottom.

"The sieve, filled with gravel, was placed in the water and turned from left to right while in a level position. Then it was quickly lowered and raised, and shaken from side to side. Finally it was swung around while tilted. After a few minutes the man removed the top gravel and threw it away, then he added new gravel to that left in the sieve, and repeated the operation over and over for an hour.

"By this time there was left in the sieve only black carbon, brown pulsat, and a small emerald of tin, in which the diamonds, if any, were to be found. The sieve

gravel is dumped into the upper end of the trough and washed down by the pressure of the water coming through from the dam above. The heavier stones and gravel are kept back and thrown away. After passing through the "long ton," the gravel of uniform size falls into a rectangular sieve, which is supported by four chains from a scaffolding in such a way that the pool below just covers the bottom of the sieve. A man stands in this water and shakes the "sieve." This gives the finishing touches to the washing. Then the gravel is brought to workers who "dig" it in large square boxes.

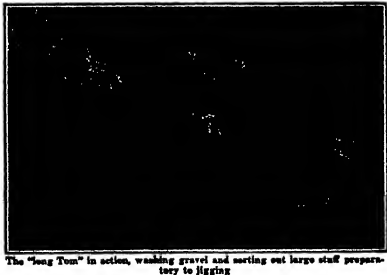
Diamonds are easily identified in the raw state by their peculiar shape and shape, but if there is any doubt about the stones, the matter can be decided by subjecting them to pressure between two knives. Almost anything except a diamond can be crushed. In color they vary from white to pink, blue, yellow, green, and black. Their shapes range from spherical to flat. Some "raw" stones from the Mazaruni region are so perfect in shape and color that it is difficult to believe they have not been cut and polished by machinery.

The supposition is that the diamonds which are found in the creek beds are the alluvial deposits of a primary formation, that is, they come directly to the stream gravels from the break-up and erosion of the rock in which they were formed. Alternate changes in temperature (heat by day, chill by night) will sometimes accomplish this, the mass having received an initial impulse or direction. All this means easier mining and a quicker turning of the stones.

The shape, and the hardness on the Kurrupung already referred to, give evidence of its history, an eighth of an inch grove on one spherical face could only have been caused by the continuous rubbing of loose material across that side, when it became exposed on the surface of the rock in which it lay firmly imbedded.

When Mr. Le Varre, on one of his earlier trips of exploration, visited the Mazaruni region he found that the natives, ignorant of the true value of these alluvial diamonds, were using them frequently for such household aids as potato-scrappers. Now the hort, or chips, had their way largely to British manufacturing plants, where highly polished surfaces of steel are required.

The one thing the native prospector has lost sight of is the fact that diamonds come from central sources, and that streaks in which they are found lead to those sources. It is hard to make a man believe that gems lie beneath one's feet, but if one is to reach the real treasure one must dig. With little or no knowledge of the Mazaruni region, what may not be looked for?



The "long Ton" in action, washing gravel and sorting out large stiff proportions to digging.

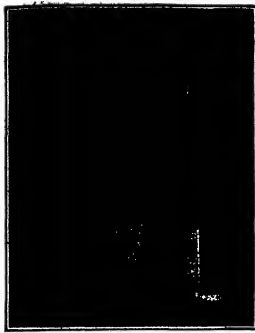
was now turned upside down on a piece of level canvas stretched on the ground by means of pegs. From the middle of the canvas the prospector picked out a small but perfectly shaped diamond of one-half carat. That stone I have at present as a reminder of the first time I ever saw a gem taken from the soil.

Somewhat in contrast to this, although essentially primitive, has been the procedure at the mine known as Le Deere. It is located in the alluvial deposits in an old bed of the Mazaruni. The river had changed its course since depositing a 30-foot pile of diamond-bearing gravel, and giant trees had grown up. These were cut down, and furnished the beams for the shaft. Here the gravel is washed in "long tons," and several sieves are employed.

The "long tons" are troughs placed at the outlet of a dam in the creek. In such are inserted three sieves of different-sized mesh. The



Entrance to a diamond mine, showing piles of washed and sorted gravel.



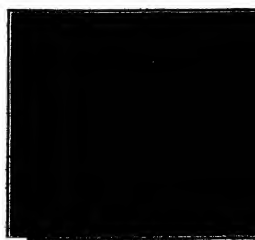
Dayton's latest landing signal for the night-flying pilot

A Beacon for Aviators

A MOTOR truck whose engine supplies electric current for lighting a powerful searchlight, is the form of a beacon for guiding aviators when flying at night, was recently demonstrated at McCook Field, Dayton, Ohio. The same engine that furnishes motive power for the operation of the motorized vehicle also is the source of current for illuminating the brilliant searchlight.

The light radiated by this new type of beacon is of high intensity—500,000,000 candlepower—and the reflector for spreading the rays of light measures thirty-six inches in diameter. By the illumination reflected from this powerful searchlight, when stationed at a landing field, the aviator when navigating the air after nightfall should be enabled to locate the landing field from a distance of 75 to 100 miles. Similar beacons are employed on battleships when at sea, but this is the first time that such a searchlight has been adapted to purpose of a field.

When the United States Post Office Department is contemplating the innovation of the carriage of postal matter by aircraft at night the necessity of marking landing fields by some form of artificial illumination is apparent. The location of powerful beacons at intervals of 100 miles along the route over which the mails are to be transported is the most common suggestion as a way of solving the problem of night-flying of airplanes. Then, too, the navigation of airplane machines after nightfall is becoming more common for general purposes as aircraft development makes a foothold in America. Some system of marking the landing fields by searchlights will have to be devised, if night-flying is to become a practice, and the beacon illustrated is a key step in the right direction.



That concrete ditch that keeps automobiles out of San Francisco's trolley tunnel

The Diply Moth and Dead Trees

THE silver moth has now spread over a large part of New England and is in position to continue its march over the adjacent states, and the rest of the land. During the past two years it has moved westward, fifty miles. At the rate of 25 miles per year, the death of our trees, especially the oaks, can be predicted by arithmetic unless help arrives in time. To combat this threat the Federal Government has been spending about \$100,000 per year, but this has only retarded the spread of the moth. Those who have seen the chestnut trees in the East standing out in the forests like giant, stark skeletons as the result of another destructive agency which rapidly spread over whole states, will not be able to envision the oaks, a more numerous species, threatened against a mass of growth. On Cape Cod, where the moth has been active, 90 per cent of the oaks are dying.

At the present spread, it will be the turn of the New York State oaks to die next, unless something is done, for the moth has already established itself along 75 miles of the eastern border of that state. Stopping the moth is like stopping the spread of a grass fire in a strong wind; if begun in time it can be done. If not, it must burn itself out. The fire spreads from all sides of the circle, but the fire-fighter can work from only one place.

Pursuing this analogy, it has been proposed to establish a barrier zone from Long Island Sound to Canada, having a width of 25 miles, beyond which the Diply moth shall not be allowed to establish itself. This really amounts to applying the same exterminating measure to a narrow strip as would be otherwise necessary to apply to the entire area infested.

Owing to the prohibitive cost of establishing control of the moth in the forests, except in a limited belt as a protective or defensive strip, it is nearly impossible to grow many of the most valuable trees to timber as in badly infested areas. Therefore these may produce little else than scrub and brush. A failure to recognize the possibility of a barrier zone, and to provide means for combating the ruthless pest within its limits may expose a large proportion of the country to the ravages of an extremely injurious insect. Just at a time when every effort should be made to conserve and increase our forests and forest products. Within such a limited area, it is scarcely a matter of overstatement, if by burning, spraying, etc., to suppress the moth entirely.

An Effective Barrier for Automobiles

AN FRANCISCO, the city of high hills and fertile ² grades, has solved the problem of getting automobiles across one of the steepest of those emences, Golden Peak, by boring a tunnel beneath the ridge. This tunnel is intended only for the trolleys, but its entrance is so situated with respect to the automobile road that

numerous automobilists have, in perfectly good faith, attempted its passage—aside from those who, in bad faith, have preferred going through to making over. Unfortunately, there is not clearance for a car and an automobile in the tunnel, and the chauffeur who moves a trolley half-way through has to back out, to everybody's great inconvenience. The trolley company finally hit upon a novel expedient for keeping the intruding automobile out of the tunnel—the concrete ditch shown in the picture at the lower left corner of the page. The ditch is three feet wide, and with the trolley rail of upstanding T-form, its negotiation by a car or truck would be quite out of the question, and no chauffeur would attempt it.



The mirror that gives the motorman a last look at his trolley wheel before entering the tunnel

A Mirror in a Novel Place

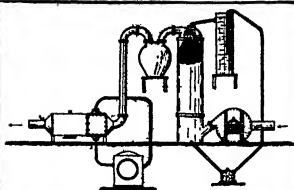
THE ingenuity of San Francisco's tunnel builders did not stop with the automobile bar described in the preceding column. The tunnel is dark, and it would be extremely difficult to replace the trolley wheel on the wire, if it should come off. In the straight run through the tunnel the possibility of its coming off is slight, but in crossing the connections at the mouth of the shaft this possibility is fairly large. So the little mirror illustrated has been installed, and the motorman is expected to assure himself that the trolley wheel is properly seated before he enters the bore.

The Talking Traffic Lamp

AUTOMOBILISTS whose driving takes them into the suburban towns of New Jersey have been treated during the past few months to a new model of traffic signal which they have found to give admirable service. The idea behind this new signal is twofold. First, it uses flashing colored lights to attract the driver's attention, rather than a fixed light. These flashing lights can be seen for a mile or more when the configuration of the road permits, and hence the driver has ample warning of the danger spot. Second, when he reaches the signal he is left in no doubt as to what he should do, what the local police regulations demand that he do, etc. At a sufficient distance from the signal to obviate the necessity of stopping to make them out, he finds that the lamp or the post or the bare carriage rail instructions—words, arrows, or whatever else is necessary. These lamps are being installed in increasing numbers at danger points and traffic centers. In the latter instance, street names and directions along the place of the arrow and the advisory lettering. Both by day and by night the motorist can read all this as he approaches, without stopping.



New traffic signal that is easy to find and easier to read



Left: Portable style of the apparatus that gives adequate ventilation in the absence of any new air. Center: Diagram showing the machine overhead. The final air enters at the right, as indicated by the arrow passing through the washing tower and chemical chamber, and issues forth in a clean and fresh state at the left, as indicated by arrow. Right: The outfit in stationary model for ventilating a chemical factory.

How a Berlin doctor has made it possible to have clean, breathable air under all conditions

Making Old Air Better Than New

By Dr. A. Gradewitz

WHATEVER the organism produces by its normal respiration and perspiration, carbonic acid and water vapor, mixed with morbid germs and the dust raised by a multitude of operations and made all the more offensive by an often uncomfortable rise in temperature; whatever industrial processes turn out in the way of unhygienic dust and bad odor, all call for a periodical removal of air. Now, what can the "fresh" air derived from inhabited areas, especially in densely populated cities, be expected to yield for ventilation purposes, filled as it is with similar impurities in addition to the dust and small left by passers-by and vehicular traffic? Still, for want of better, we had so far to be satisfied with this outside air, both in opening our windows for the sake of ventilation and in connection with those ventilation plants admirable from other points of view.

A medical practitioner living in Berlin, Dr. Albert Wolff, has devised a remarkable new scheme enabling the air in a closed room, within a minimum of time, to be perfectly regenerated, eliminating even the most offensive odors, any trace of dust and morbid germs, disposing of any surplus carbonic acid and water vapor, as well as lowering its temperature in summer and raising it in winter—all without any supply of outside air. The process has now been developed to a commercial stage and, but for economical conditions at present prevailing in Germany, would long have been in operation on a large scale.

The process consists of three consecutive stages, the first of which is optional, the remaining two compulsory. Whenever, in fact, dust of an especially coarse description is raised in the rooms to be ventilated, an incompressible mechanical filter should preferably be inserted in front of the apparatus, thus reducing its wear and tear. This, of course, is quite independent of the process proper, the underlying principle of which can be stated as follows:

The air to be regenerated is, by a combination of electrically designed pumps with a washing process, whirled around into swirling motions in order to appear the smaller of scale, in the water of a washing tower. After being thus served over the water, as great as possible, the air, still still from, passes into contact with an electrically induced solution, automatically supplied from a telescoping device, thus being freed from all morbid germs, and, as previously, subjected to a washing process. The moisture of the air is then removed by means of a series of Jars, and the air, now very dry and heavy, is drawn off by means of a pump.

The oxidizing solution is obtained by the action of ozone on metallic chlorides. The reagent, after escaping from the lower part of the washing tower, is automatically regenerated in a continuous cycle, so as to be used over again. Any possibility of free ozone entering the ventilation air and thus irritating the organs of respiration is absolutely excluded. The air escaping from the top of the washing tower passes through a drip-pitcher and across boxes, enabling its temperature and moisture to be adjusted at will. The whole of the oxidizable matter is submitted in the washing tower to the continuous action of nascent oxygen. The most offensive odors are totally absorbed by the apparatus. Morbid germs from the nasal cavity, according to tests made at the principal Berlin hospitals, are annihilated completely. The most remarkable feature in this connection is that on account of the instantaneous destruction, the apparatus always is sterile and never, like other filters, becomes a focus of infection.

The carbonic acid of the entering air is, by a special chemical process connected with the filter material, reduced by degrees. An apparatus dealing with about 800 cubic meters per hour takes up a space of about two cubic meters and requires an expenditure of about three kilowatts per hour for its operation, inclusive of the cooling effect.

The very finest dust particles suspended in the air

and on which all filters so far in use had been without any effect can thus be disposed of. The process will prove especially invaluable in the case of industrial plants the operation of which is connected with the production of offensive miasms. Refrigerating chambers will derive great profit from its use, while the air in hospitals can by means of the new process be controlled at will, so as to contain only disinfected air and medicine. During the war, use has already been made of the process for the aseptic treatment of wounds without any drawing in Berlin military hospitals. If economic conditions at present prevailing allowed of the expense, it would be possible with it to allow of draught to ventilate hospital wards with an individual atmosphere corresponding in any special condition.

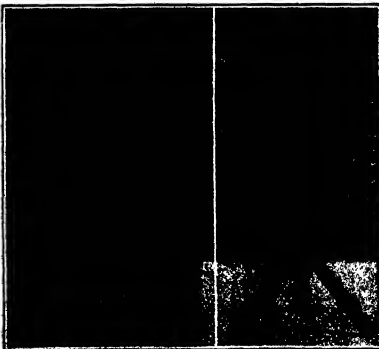
An additional advantage is that, wherever required, any valuable material can readily be recovered from the air thus treated. This possibility has already been made use of in the chemical industry.

This German device presents an interesting development in ventilation problems. Heretofore, the usual idea has been to expect foul air and take in fresh—or so-called fresh—air from outdoors. There have also been devices for producing ozone for the purpose of destroying bacteria in the foul air, but, as pointed out, this pungent gas irritates the lungs. In rounded districts the problem of good air is a pressing one.

Chemical Analysis With the Spectroscope

SEPARATION by ordinary means of sufficient quantity of an impurity to determine its nature is often a lengthy process. With a spectrometer, on the other hand, the presence of spectral lines characteristic of a given impurity may be derived at once. In many cases as little as one part in 100,000 can be observed continuously and without error. In some cases, quantitative determination is even possible, the time required for the disappearance of the line in the arc being a measure of the amount of the impurity present.

Improved apparatus for such determinations as these is recently on the market. It is similar in appearance and size to a microscope, as our views show, and takes no more room on the table. The telescope has in its eyepiece a slit and a small autocollimating prism for introducing the light. After passing through the object glass the rays of light proceed to the 90-degree prism. This is silvered on its back surface, and the light returns its path through the object glass to the eyepiece, hence of which the spectrum is viewed. The prism is mounted on a table provided with a lever, and is rotated by means of a micrometer screw pressing against the lever to which screw is attached a drum, on which is engraved the scale of wave-lengths. The index moves along a helical slot.



Recently developed "spectrometer" for applying the principles of spectroscopy to chemical analysis

What Makes Glue Stick?

Some Studies of the Roles Played by the Wood and by the Adhesive

By Eloise Gerry and T. R. Truax

Of the staff of the Forest Products Laboratory, Madison, Wis.

WOOD, because of its cellular structure, can be glued more easily than many other materials, such as glass or metals. The adhesive is forced into the hollow air spaces, the cell cavities or the pores of the wood, where it becomes firmly anchored.

When a good glue has become set, it is possible to shear or tear apart the solid wood without breaking the glue joint.

The accompanying pictures of plywood as seen under the microscope, illustrate the appearance of some veneers glued together with the grain of alternate plies running at right angles to each other. The manner in which the glue enters woods with different types of structure is shown.

The material here presented was obtained in the course of investigations now being carried on at the United States Forest Products Laboratory to determine the effect of various isolated factors, such as wood structure, pressure, length of assembling period, moisture content, and temperature of the wood, upon the results secured in gluing different species of wood with different kinds of glues.

Glues which are commonly used as adhesives for wood may be classed as (1) animal and fish glues, (2) vegetable glues, (3) casein glues, and (4) blood albumen glues. For a comparison of different glues as to manufacture, properties, and uses see Report No. 95 of the National Advisory Committee for Aeronautics, entitled "Glues Used in Airplane Parts," by S. W. Allen and T. R. Truax.

In all the woods examined it was found that the various glues did not penetrate the cell walls but entered only the exposed openings of the cell cavities. As is evident in one photograph, where two plies of veneer are glued at right angles, the manner in which the glue penetrates is chiefly due to the fact that the veneers were cut in such a way that a very slight cross grain (as it appears under the microscope) is present. This permits the glue to penetrate the wood through the cell openings (thus exposed (4, in the photograph) which extend away from the spread surface at a slight angle. If the cross grain is pronounced, however, it weakens the veneer and the glue is permitted to penetrate to the outer surface of the panel and produce undesirable staining. At *B*, on the panel, (shown on the penetration as it appears on the end grain. From this it is apparent that the diagonal penetration of the glue may extend some depth below the spread surface. Were the manner of its entrance not

realized, the appearance of the penetrated pores at *B* might mislead one into thinking that the glue had penetrated directly through the cell walls from the spread surface, instead of only through cavities, which at some point are in contact with the spread surface.

is illustrated by the fourth and fifth views, showing joints in which the glue enters the pores of the wood at hand, air pockets (4, in the first view) or undue forcing of the glue out of the joint may materially weaken the panel. It is not necessary for the glue to penetrate for a long distance into the wood, if only a sufficient anchorage is obtained all the way along the joint surface. Numerous relatively shallow glue pockets, such as are made by the penetrated fibers at *F*, in our last photograph, are probable to a deep penetration, but isolated, cells.

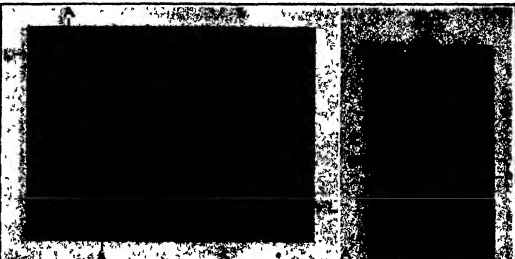
Relatively large cavities, such as those of the pores or vessels of hardwoods, as in red oak, mahogany, or birch, are penetrated with considerable ease, especially when they are not closed by tracheids or gums. Hence, for the most part, when abundant pores are present, the longitudinal surfaces of relatively coarse-textured woods can be glued very readily in joining end-grain surfaces.

On the other hand, large, open pores tend to absorb too much glue and cause a softened joint. Unless special precautions are taken, the unevenness of the distribution and the abundance of the pores, especially on longitudinal surfaces, are very significant factors in successful gluing.

From a standpoint of the number and distribution of pores, it is obvious that with the same treatment hardwoods could be glued more easily than oak, where surfaces practically lacking in pores may occur. If the pores were the only means for holding the glue, European beech and black walnut would be found relatively difficult to glue. The general penetration of the fibers, *F*, in our second view, is a significant factor in such woods, however, and it is none the less necessary if a strong joint is to be obtained.

Woods having fine texture, or a large proportion of cells with small cavities, may require different treatments, especially with glues of relatively high viscosity. The fibers of white oak, hickory, black walnut, and ash, are examples of wood structure where special attention is usually necessary in order to force the glue into the smaller cavities.

Our fourth and fifth figures show the manner in which the glue penetrates the pores of the wood. The penetration occurring in the end-grained surface, (note the diagonal penetration of the glue into the pores of the wood, in the first view) is illustrated by the fourth and fifth figures, showing joints in which the glue enters the pores of the wood at hand, air pockets (4, in the first view) or undue forcing of the glue out of the joint may materially weaken the panel. It is not necessary for the glue to penetrate for a long distance into the wood, if only a sufficient anchorage is obtained all the way along the joint surface. Numerous relatively shallow glue pockets, such as are made by the penetrated fibers at *F*, in our last photograph, are probable to a deep penetration, but isolated, cells.



Left: Through air pits glued with blood albumen glue. Only enough pressure was applied to keep the veneers in contact. Note the wide glue lines, *A*, and air pockets. *A* Right: Spanish cedar glued with blood albumen glue. There are few pores, *F*, and they are rather isolated. Penetration of the fibers, *F*, therefore greatly strengthens the joint.

Typical glue joints of different characteristics



Left: Blood glue joint between hawned veneers. The glue has penetrated slightly through the pores, *F*, and has been forced out of the pores of the surrounding fibers, *F*. This is a typical view of any penetration. Center: Blood glue joint with blood albumen glue under pressure of 15 pounds per square inch. Note wide glue line, *A*, penetration, *F*, and the pores, *F*, in the fibers. *F* Right: Same combination, but glue under increased pressure. Here we have a narrow glue line with good penetration in fibers as well as pores.

Some more details of glue penetration under different conditions

then, as *A* to *G* in the left view of the bottom group, provided a continuous film of glue is present, and sufficient penetration is obtained, the thickness of the glue line in the joint may vary considerably without appreciably affecting the strength of the union. This

over, the additional penetration of the glue into the pores of the wood is a factor in the strength of the union. This is especially true in the case of the glue in the pores of the wood. It is not necessary for the glue to penetrate for a long distance into the wood, if only a sufficient anchorage is obtained all the way along the joint surface. Numerous relatively shallow glue pockets, such as are made by the penetrated fibers at *F*, in our last photograph, are probable to a deep penetration, but isolated, cells.

(Continued on page 107)

Solders for Aluminum

CIRCULAR No. 75 of the Bureau of Standards entitled "Solders for Aluminum" has recently been revised. It will soon be available from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 5 cents a copy.

Most of the metals commonly used in solder, except magnesium, are electro-positive to aluminum, so that any metals used in making a soldered joint of aluminum act electrolytically in the presence of moisture as pool five galvanic cells accelerating the corrosion of the aluminum. Magnesium cannot be utilized advantageously even though it is electro-negative to aluminum because the metal disintegrates rapidly in the presence of moisture. Therefore, soldered joints of aluminum which are to be exposed to moisture should be protected against corrosion by paint or varnish. Various compositions of zinc and zinc-in-aluminum solders give the best results.

The tensile strength of a pool aluminum solder is about 7000 pounds per square inch, because with higher tensile strength usually have such a high temperature of complete liquidation that they are unsuited for soldering. Usually the strength of an aluminum soldered joint depends upon the type and workmanship.

A Draw Bridge Which Slides Diagonally

THERE is something decidedly different about the draw bridge shown in the accompanying illustration, even though it has been in use for several decades. Because of the limited space available, this bridge, which spans the Bronx River in New York City, has had to be designed along somewhat unorthodox lines. It is mounted on flanged wheels which ride on rails laid diagonally to the line of the bridge. When the bridge is to be opened for river traffic, the bridge attendant pulls the bridge along the diagonal rails by means of a winch. Hence the bridge moves to a position parallel to, but a short distance below from the usual location by means of this diagonal movement.

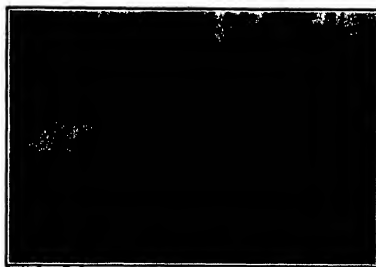
Putting Out Oil Tank Fires With Water

THE application of water in the extinguishing of oil tank fires was successfully demonstrated in San Francisco recently before representatives of various oil companies. The demonstrations were given near one of the municipal fire engine houses, where a tank 20 feet in diameter and 4 feet high, and a tank 12 feet in diameter and 4 feet high, were installed, both tanks being connected with a central pump having a capacity of 500 gallons of water per minute at a discharge head of 100 pounds per square inch. The pump was directly connected to

a 50-horsepower electric motor.

The 20-foot tank has 114-inch lines each 7 feet 6 inches long, radiating from the center of the tank to separate individual water distributors spaced equidistant circumferentially. During one of the demonstrations 12 inches of oil or 600 gallons was used in the 12-foot tank and allowed to burn until the fire was going strong, the fire being extinguished in five seconds with 25 gallons of water. The fire was actually out in less than five seconds, in fact, almost immediately on the application of the water curtains which is produced by the water distributors, the latter spreading an umbrella curtain of water over and above the surface of the burning oil.

A four-inch water meter is installed in the suction line leading from a 8000-gallon water storage tank to



This bridge moves out of the way for passing river traffic by sliding diagonally on the rails shown

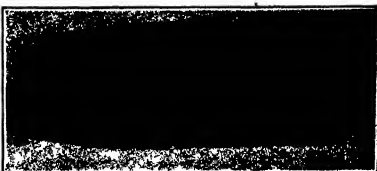
the pump and a pressure gauge, as well as a quick opening valve installed in the discharge line near the pump. For the purpose of regulating the water curtain, as well as being necessary to block off the line not in use, a screw stem gate valve was installed on each line to each individual tank, and a pressure gauge connection was placed in each line near the tanks.

This installation gives sufficient flexibility to regulate to a nicety the water curtain desired, in addition to being able to take readings on water column and pressure developed friction head loss in line etc.

The water distributor is the invention of a San Francisco firm by the name of Morrey.

A Crane Which Removed a 150-Ton Bridge Inland

OUR illustration shows how a large floating crane, because of its great lifting power, may effect under certain conditions a considerable economy in time and labor in this case a new 200-ton floating crane was brought into service in connection with the reconstruction of the landing stage at New Brighton near Liverpool. As part of the work, it was necessary to remove the two steel passenger foot-bridges, leading from the end of the ferry pier to the floating landing stage. One of these is 125



Experimental fuel oil tank equipped with a new system of water distributors for extinguishing oil fires

tons in weight and 160 feet in over all length. The other weighs 140 tons and measures 177 feet over all. The work was done in December, and because of the heavy fog which runs at times at 7 knots in the Morrey, and also on account of the unsettled weather in December, it was necessary to complete the job of removal in one day.

After the floating crane had been brought alongside the landing stage, the bridge was lifted by four slings attached to the lower chords of each of the main girders at about the third points, the slings consisting of specially flexible wire rope, six inches in circumference. Each double sling passed around a hardwood block on the under side of the bottom chord.

When lifted, the overhanging portions beyond the slings were, of course, subjected to complete reversal of stress, tension members becoming compression members. The diagonal tension bars in the overhanging portions were relieved of compressive stress by means of slings passing from the upper panel point to the opposite lower panel points in the opposite direction to the tension bars in those panels.

In the work of removal, the 200-ton crane was towed up to position alongside the landing stage, the JB was derrick around over the bridge to be lifted, and the lifting blocks made fast to the slings above mentioned. In five minutes the bridge had cleared its bearings on the pier. The JB with its load was then steered round and the bridge deposited on the deck of the crane barge.

The crane was towed some two miles and moored to the river wall just south of the Macdonald Ferry, where the bridge was lowered on to timber grillages prepared to receive it. The work of removing the two bridges, transferring them two miles to their temporary resting place, bringing them back, and putting them in position again, was done without any delay.

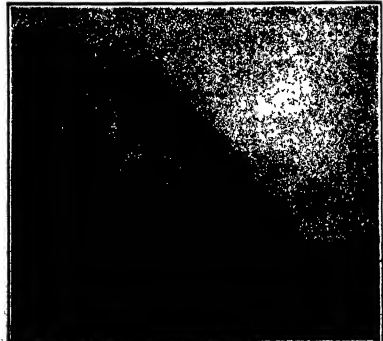
Auxiliary Condensers and Loading Coil

A FOURTH circular in the series of descriptions of a very simple radio receiving outfit prepared by the Bureau of Standards has just been issued. This is Circular No. 127 entitled, "Auxiliary Condensers and Loading Coil Used with Simple Homemade Radio Receiving Outfit," and can be obtained from the Government Printing Office at 5 cents a copy.

Circulars 120 and 121 described a single-circuit receiving set and a two-circuit set, respectively. The operation of either set can be improved by the use of a very simple and cheap condenser connected across the telephone receivers and a similar one connected in series with the antenna. Longer waves can be received by the use of a very simple type of loading coil which is particularly useful in connection with the single-circuit receiving set.

The auxiliary condenser, which is used in series with the antenna and the loading coil, may also be used when the crystal detector is replaced by an electronic tube detector unit (as described in Circular No. 128), or when an amplifier (to be described in a later circular) is added to the receiving set.

The condenser used in series with the antenna makes it convenient to tune to wave lengths less than 300 meters. The use of the condenser across the telephone receivers increases the intensity of signals which are received from some radio stations. The loading coil enables the equipment to receive signals above 300 meters, up to about 3000 meters. These signals from high power stations can thus be received.



Crane floating crane lifting a 140-ton bridge, intact, to the crane piers, during a stage of reconstruction

Concrete in the Making

Ingenious Production Methods Evolved in the Portland Cement Industry

By George S. Eaton

MOUNTAINS of rock, in effect must be powdered yearly in the portland cement plants of the country before the carefully proportioned raw mix can be put through the flaming kilns where it is burned into clinker. This glow-hard material in turn is pulverized to produce portland cement. And since the substances that must be reduced to such quantities to the fineness of flour are solid rock and harder (clinker special equipment with many novel features has been devised to do the work efficiently and rapidly. Huge plants in which such expensive machinery now supercede this basic building material for use in all sorts of concrete structures and pavements.

Without two great inventions the portland cement industry could not have attained its present development. One of these was the rotary kiln which has entirely replaced the old down-draw kilns in this country. Although greatly favored for coal the rotary kiln is low in labor cost and what is of greater importance makes production on a mammoth scale feasible. Instead of a vast hundred barrels a day from the improved continuous down kiln the modern rotary can turn out a thousand barrels or more five or sixfold.

Coincident with this development in kilns and of equal importance came the evolution of the iron grinding mill. Anyone who is familiar with an old-time plant with its forty or fifty mill pillars busy with their hammering, shattering the stones once used in grinding, materials will admit that present day outputs would not be practicable without the highly developed iron or steel grinding apparatus of today. And the development in either of these two mechanical fields alone would have been insufficient—their correlation was essential.

The huge rotary kilns found today in the cement plants of the country make most unusual furnaces. If one of the largest could be set on end it would be as tall as a 20-story building. It is more than big enough to hold a touring car if you wish. It is heavier than four standard millium cars. Several of these steel monsters slowly revolving side by side in a great kiln room with 30-foot tongues of flame roaring within them and white-hot clinker dripping from their mouths create an impression of power and relentless purpose that is unparelleled.

The raw mix, consisting of properly proportioned and finely powdered ingredients enters the upper end of the kiln. As this slowly turns a revolution every minute and a half or two minutes, the powder is carried up the side before it tumbles down and forward due to the kiln's slight inclination to the horizontal. As it tumbles in the raw mix is stirred over and so the material grows better and better. The fine carbonate begins to give up its carbon dioxide. At the time the temperature reaches 1250° Fahrenheit, a third of the original weight of the mixture has gone up in



A centrifugal type of mill for pulverizing material in the cement plant.

smoke as carbon dioxide alone. If a few Hunsome were being used without the clinker elements added, the loss from this source would be 60 per cent.

Now the material begins to get really hot, the glow ceases. Near the lower end of the kiln the flames attain a temperature of from 2000 to 2500 degrees Fahrenheit—a heat great enough to melt the steel shell of the kiln. If it were not for the protection of the fire-brick lining at this temperature, the materials are at the point of incipient fusion and in their finely powdered state, react chemically to form the clinker that is later ground into portland cement.

The fuel employed to produce this extreme temperature is usually powdered coal. Itself the result of pulverizing operations like those to which the raw materials are subjected. Coal so finely ground burns almost like a gas flame. Millions of tons of pulverized coal are consumed every year in the kilns of the cement mills. Great quantities of fuel oil and natural gas are also used.

Control of the burning is a most important feature in cement manufacture. The visitor at a cement plant will notice standing near the flame end of the kiln a workman who from time to time holds up a pair of goggles and peers into the great cylinder. Protected by these colored glasses, he is looking into a veritable inferno of heat noting the appearance of the clinker as it tumbles over and over on its slow advance toward the outlet. From this inspection with the aid of the more precise information furnished by recording pyrometers and draft gauges set near the exit from the kiln to the stack the burner is able properly to control the clinkering action by varying the amount of coal blown in and the rate of rotation of the kiln.

Occasionally rings of clinker form some distance back from the lower end, materially cutting down the effective diameter of the kiln and actually damming the flow through it to a considerable extent. These rings may become three feet thick and extend into the kiln 10 to 15 inches from the flange. To remove them with hand tools necessitates stopping the kiln and heating it all down, with the certainty of a loss in production and the possibility that too rapid cooling will damage the shrinking fire-brick lining to crack. To eliminate this large operating loss, some ingenious inventors devised the plan of shooting a hot jet of steam into the kiln, so it relapses.

Rough handling a sharp of one corner of bed exposed because of the bulk of the ring, should not be essential, so that eight or ten guns are provided in order that they will not become too hot. One gun after

while others lead. The blast of coal dust is shot off to afford a clear sight, but the kiln is allowed to revolve in order to prevent the clinker sticking to the lining. From 200 to 1000 shots must often be sent into the moving target, which means that the workman's shoulder receives a terrific pounding from the recoil of the heavily loaded guns. Unusual as it is, this plan has been used with much success at some plants.

Clinker is an interesting material in itself. It is formed by the physical and chemical union of the particles of raw materials brought into close contact at the very high kiln temperature, which, however, is still below the true fusion point. It consists of dark colored pieces, roughly spherical, ranging in diameter from one-quarter of an inch or less to as much as two inches. Even though the raw mixture includes such materials as clay or marl, the resulting clinker is glass-hard and difficult to pulverize. It is a totally new material.

Then there is the matter of color. Although clinker is almost black, the cement made by grinding it slowly is gray in color. The only addition to the clinker is about 5 per cent of gypsum, which has little effect in coloring the cement. The latter's much lighter color is due to the difference in the absorption and reflection of light by the clinker before and after pulverizing. Powdered materials often exhibit some such changes in color.

While clinker needs only to be ground to become cement, which is a substance that possesses solidity into a permanently rigid mass upon the addition of water, clinker itself is inert and can be exposed to the elements for months without deterioration. Frequently it is embedded with water while cooling. Fine pulverizing is necessary before any cementing action can take place.

Present grinding machinery commonly utilizes the principle of pounding the material between some form of hammer and another metal mass. But the hammer may be a steel ball.

For example, a charge of several tons of steel or chilled iron balls hammers the rock fragments into bits in the ball mill often used in the first stage of grinding rock or clinker. This mill is a horizontal steel cylinder six to eight feet in diameter and four to six feet long. It makes a revolution every two and a half seconds about its horizontal axis. The balls used are of two sizes, the larger are five inches in diameter and weigh about 18 pounds each. In use, these balls rapidly wear away, so that from time to time the worn ones must be replaced by new balls.

As the cylindrical mill rotates, the balls are carried up the ascending side only to be thrown out and down to the bottom again. The principal grinding action is said to be in the sharp blows delivered by the steel balls as they strike the particles caught between them.



Shooting a hot jet through a clinker ring in a kiln may save a two-day shut-down.

and the slabs at the bottom of the drum. The crushed material, however, is telescoped in, dot in and dot out, as it passes. When fine enough, it passes out through an revolving screen that is fastened to the steel lining, and passes with the mill. The particles leaving the mill mostly are about the size of medium-sized field grains.

Other machines often used for grinding are known as hammer mills. In these, swinging hammers deliver the blows that break up the materials. Still other even more common types are called centrifugal mills, since their operation is dependent upon centrifugal force.

In one particular kind of centrifugal mill a single steel roll is suspended on a vertical shaft attached to a pulley by a universal joint. The roll is rapidly rotated, and swings out as it revolves until it bears against the inner face of a steel ring or circular disc with great force. The pieces of rock caught between the two are ground up. When fine enough, these particles are moved up and forced through enclosing screens by fans set over the roll. Such a mill is an efficient pulverizer.

Steel cylinders 20 feet or more in length are very often employed in reducing the product coming from the ball mill to the very fine powder that is fed into the kilns. These are filled about half full with flat pebbles, or more commonly since the war, with steel balls and slugs. The latter are small cylinders about an inch long by a half inch through. Such mills are known as tube mills.

Almost any operation in the long manufacturing process contributes something unusual. For example, consider the sacks of cement seen on practically any street. Almost any operation in the long manufacturing process contributes something unusual. For example, consider the sacks of cement seen on practically any street. Almost any operation in the long manufacturing process contributes something unusual. For example, consider the sacks of cement seen on practically any street.

—yet these sacks were accurately tied with steel wire before they were filled with cement. This operation of filling a banded container is performed many millions of times a month, for in 1922 enough portland cement to fill over 430,000,000 of them was produced in this country.

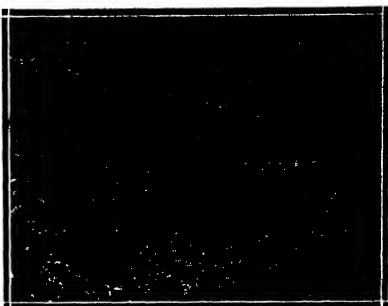
Less than 20 years ago the filling of cloth or paper sacks with cement was still a slow, back-breaking operation. Cement was stored in bins and workmen filled the sacks with shovels. As every sack had to contain 94 pounds, it was necessary to stop and weigh each package before it was tied, adding materials as needed to bring it to the standard weight.

Today the filling is done by machines, and these machines have brought with

them this type of sack that is tied before it is filled. The sack is provided with a self-closing valve in the bottom through which cement flows in, aided by an elaborate mechanism.

When the requisite 94 pounds of cement have been put into the bag, the flow is cut off by means of a scale, automatic in operation. The full sack then drops to a moving belt that carries it out to the freight car. By this method a crew of four men can fill and load 3000 sacks a day against an output of 1000 under the old hand-labor methods.

The valve itself is made when the cloth sack is sewed up, by folding over one bottom corner before a man is run along the bottom and up one side of a doubled strip of cloth. When the sack is now turned right side out this flap valve forms an air lock through which cement can flow. The sack is hung on the filling machine upside down with an inch tube



Cement clinker is an inert substance, but when ground into cement it soon hardens on addition of water. The grinding before it does from the steel rollers, is an almost insipid powder that will pass through silk cloth.



Both the preliminary and the final grindings of the clinker and the cement itself are carried out in ball mills of one sort or another, of which this is a very common type, except, broken away to reveal the mechanism.

Inserted through the valve. Once filled and tightened, the sack is proof against leakage, since the weight of the cement holds the flap valve closed.

In the raw materials from which portland cement is made the major constituents—lime, silica and alumina—must be present in the right proportions. Also they must be unaccompanied by injurious amounts of other ingredients. Proximity to centers of population is desirable, as freight charges mount up rapidly upon such a heavy, low-priced commodity as cement. This means that usable deposits suitably located for economical manufacture are comparatively rare. Yet the raw materials themselves are a small part of the cost of cement manufacture, as it is the great amount of machinery, the fuel for burning the clinker and the power needed to operate the mills that are the important factors. Last year portland cement was made

wet. These vary in methods but not in principle. In the dry process, rock is crushed to a two-inch size by passing the pieces from the quarry through some sort of a primary crusher, followed by a battery of smaller ones. Materials are next dried, and then go to the grinders mill for pulverizing before they are burned.

Slurry is the term applied to the raw mix in the wet process, used where water is an ingredient and in some instances with limestone added. Enough water is added to the materials so that they can be ground into the soupy mixture called slurry. This is often reduced to an even finer state than is the case in the dry process. In order to secure a uniform mixture, harrows much similar to those used on the farm, but with enormous teeth, may be dragged around in the tanks into which the clay is dumped from storage before it is added to the mixture, keeping it constantly agitated. The slurry is pumped like water into feed tanks, from which it passes to the kilns.

Careful methods of control in manufacturing cement have of course been worked out by the cement plant chemical and physical laboratories, as the product is sold to conform to the specifications adopted by the American Society for Testing Materials, and the United States Government.

Among the many unusual pieces of apparatus relied upon in testing cement, none of greater interest than the 200-mesh sieve. One of the requirements is that

(Continued on page 148)

Where the Temperature Is 434 Degrees Below Zero

The Work of the Bureau of Standards in Liquefying and Freezing Hydrogen, Lightest of Gases

By S. R. Winters



THE LOWEST temperature ever recorded in Western Europe, possibly the coldest degree yet attained in the United States, was achieved recently when Dr. W. B. Kean of the Low Temperature Laboratory of the Bureau of Standards, United States Department of Commerce, produced solid hydrogen. The thermometer used registered 454 degrees Fahrenheit below the commonly accepted zero point, and only 25 degrees above absolute zero, which is 426 degrees Fahrenheit. Liquid hydrogen was manufactured at a temperature of 421 degrees Fahrenheit; the fluid then being easily transformed into flakes resembling snow or ice.

Hydrogen—a gaseous element that is colorless, tasteless, odorless, and the lightest known substance—has heretofore been converted into a liquid and a solid. About a quarter of a century ago Sir James Dewar, a noted English physicist who died on March 27, 1923, first produced liquid hydrogen, and two years later he realized the production of solid hydrogen. Dr. W. B. Kean and his co-workers at the Low Temperature Laboratory of the Bureau of Standards, however, are probably the first scientists to achieve the distinction of devising a method whereby both liquid and solid hydrogen may be dependably manufactured in quantity production.

Dr. Kean is tackling the production of liquid hydrogen with a two-fold object in view. First, gaseous hydrogen leads itself to the attainment of extremely low temperatures, and by extensive experiments the Bureau of Standards estimates that this operation will be established on a practical basis. Second, these investigations have for their purpose the solution of difficulties arising from the methods of manufacture, thereby facilitating the installation and operation of hydrogen liquefiers in Government and university laboratories. A relatively small quantity of liquid hydrogen was first manufactured at the Bureau of Standards several years ago by T. B. Ford, then a member of the staff of the Low Temperature Laboratory. He employed old and extremely troublesome machinery. Recent experiments, however, have been suggested through the use of newly installed apparatus, and several liters of liquid hydrogen can be produced hourly without experiencing much difficulty from the slightest variations in temperature.

The method of converting gaseous hydrogen into a liquid state is somewhat analogous to the process of manufacturing liquid air. Briefly told, this method consists of, first, in compressing the air to a high state of compression, approximately 500 atmospheres, or the application of 3000 pounds of pressure to the square inch. The resultant heat is dissipated and the air is partly purified. It is then preferably, but not necessarily, pre-cooled to a point of a few degrees below ordinary or room temperature. The air is subsequently given passage through a heat interchange and permitted to expand to atmospheric pressure through a valve. The expanded air is allowed to pass back over the heat interchange, the result of cooling the incoming compressed air. Thus a negligible quantity of cold is squandered. The apparatus cools until a column of the air is transformed into a fluid.

Hydrogen is liquefied in a similar manner, save in one respect. Instead of beginning the process of manufacture while the gaseous hydrogen is at room temperature, the compressed gas is first cooled to about 200 degrees Centigrade, which depending point on the thermometer scale is attained by the forced evaporation of liquid air under reduced pressure. Several difficulties are encountered during the course of this process

of manufacture, notably among these obstacles being the impurity of the hydrogen as delivered, trace of air in the latter, wetness out solid air in the expansion valve and specially clog the mechanism. This untoward circumstance occurs even when the hydrogen seems to possess 100 per cent purity, according to the conventional methods of gas analysis. The absence of

As a standard against which to compare the freezing point of hydrogen, around which Mr. Winters' story revolves, the following temperatures may be borne in mind:

Mercury freezes at	38 below
Coldest weather ever observed in U. S.	61 below
Coldest weather observed in world	90 below
Alcohol freezes at	142 below
Oxygen liquefies at	297 below
Nitrogen liquefies at	319 below
Nitrogen freezes at	347 below
Oxygen freezes at	360 below
Hydrogen liquefies at	421 below
Hydrogen freezes at	434 below
Absolute zero, at which matter may	
come to exist	459 below

These temperatures, like those in Mr. Winters' text, are in the familiar Fahrenheit scale, rather than the Centigrade that is ordinarily used in scientific work.—THE EDITOR.

extremely sensitive apparatus for melting determinations of the purity of gases is requisite for this condition. Nitrogen is the objectionable impurity in hydrogen. Thanks, however, to a process developed at the Physical Nitrogen Laboratory of the United States Department of Agriculture, it is possible to analyze gaseous hydrogen at the different stages of its production and use

two-one-hundredths per cent of nitrogen. The oxygen and nitrogen admixture is eliminated by passing the gas through a separate element by an apparatus that dispenses without heat to the gas to effect a combination of the oxygen and hydrogen. Any water present can be removed by common drying agents; and, in fact, the presence of a trace of water does not involve a serious difficulty, the water is temporarily absorbed, but in recent operations this auxiliary unit has been discarded for the time being.

Liquid hydrogen is the lightest fluid known. The figure of speech, "light as a cork," is thrown into disrepute when compared with the weight of hydrogen in a liquid state. A cork, for instance, sinks in liquid hydrogen because it is three or four times as dense as this fluid. A container of liquid hydrogen is so light that one cannot easily detect the presence of it in its vessel by any additional weight it imparts. Its viscosity is exceedingly low—about one-sixteenth of that of water. Hydrogen in a fluid state, like compressed air, may be preserved for 24 to 48 hours by means of vacuum-walled containers. The latter are barriers to the entrance of heat from immediate surroundings. Pressure alone, however, will not preserve either hydrogen or air in a fluid state.

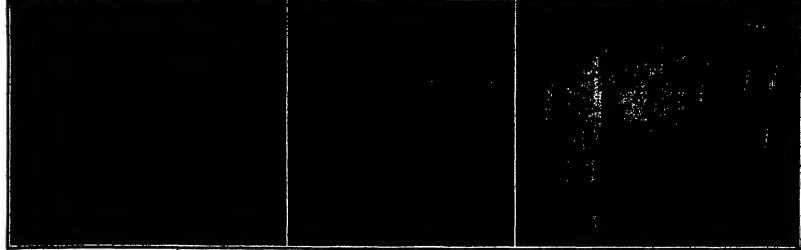
Once gaseous hydrogen has received itself into a liquid, the transformation to a solid is a simple matter, and the result is accomplished. The fluid is reduced to a lower temperature—approximately eleven degrees on the thermometer scale—below the temperature of a partial vacuum. Solid hydrogen bears similarity in flake of snow and ice and they are extremely light. It is difficult, if not well-nigh impossible, to preserve hydrogen in a solid form for any duration of time. For example, Doctor Kean's was unable to carry a specimen from the laboratory for a distance of four or five miles before the flaky substance melted. However, according to the method being employed, it can be manufactured fairly rapidly and dependably in quantities desired. Solid hydrogen is the lightest solid known, it being one-third lighter than cork.

Sir James Dewar, inventor of the well-known vessel that bears his name, and the first person in the world to produce liquid hydrogen in a sufficient quantity to be positive of his achievement, recently died at his home in England. Postmarked, is it not that the efforts of his research should be continued without interruption and attain full fruition at the Bureau of Standards of the United States Department of Commerce? The Dewar vessel is essential in the process of manufacturing both liquid and solid hydrogen. The first liquid hydrogen placed on exhibit in the United States was that displayed by Professor Dewar at the Lewis and Clark Exposition in 1904. Subsequently, Government agencies and educational institutions have sporadically manufactured the product for use in the laboratories of Cambridge, High Ouse, at London, Melbourne, the University of California, in American laboratories in Washington, California. However, it remained for the Low Temperature Laboratory of the Bureau of Standards, United States Department of Commerce, to apply a standard of production and dependability to the production of liquid and solid hydrogen. This is possible, not only on its own ground, but equally in view of the fact that it makes the desired product by the routine of its own processes with respect and saving of the absolute low-temperature value; it guarantees, as an additional advantage, that it does not serve as an extraordinary laboratory waste.



Dr. Kean of the Bureau of Standards at the hydrogen liquefier, wherein he is producing liquid hydrogen regularly, in quantities.

and locate the source of contamination. For its own needs the Bureau of Standards is manufacturing hydrogen by the electrolytic method. This gaseous substance is collected in a holder, containing oil of sulfuric acid, and is compressed into cylinders for storage. As the hydrogen comes from the generator it contains approximately one-hundredth of 1 per cent nitrogen, which, subsequent to compression in cylinders, possesses



Left: How six portable handcranks are combined to make a single package, where one would be quite impracticable. Center: The problem of shipping automobile tires without being the tire or being upon it is not by packing them in a hammock box. Right: The extremely clever crate carries six coils of ready for export in perfect security.

Trick boxes that are necessary for long-distance shipping of merchandise of trick shapes

When the Packer Turns Inventor

AMONG the ancient proverb there is one that tells us something about the advisability of cutting one's garment to fit one's cloth. Presumably the original author of this bit of sage advice did not know anything about packing merchandise for shipment. If he had, and if he had had before him the examples of how to perform this difficult task which we see at the top of this page, he might have modified his proverb a little differently, making it have reference to the extreme advisability of building the box to fit the contents.

All of us, presumably, can make a fairly presentable job of wrapping a bundle—just so long as the bundle preserves the shape known to the mathematician as a parallelepiped. When the square corners make way to round ones or even to projections, and when the flat sides give place to concavities of outline, the difficulty of draping the article in paper and string is vastly increased. And when, instead of paper and string, it must be draped in a wooden box that will stand up against all the rigors of ocean freight shipment, the shipping clerk has a problem on his hands that calls for no little expenditure of gray matter.

One line of attack resides in the use of boxes or crates with internal partitions or compartments. High voltage porcelain insulators are an example of the sort of merchandise requiring such treatment as this from the packer. They are of awkward shape to begin with, and invariable in the bargain. Instead of trying to make a box that will hold one of them, they are rilled up, six high, in a long and narrow crate, as illustrated. With all the protruding parts of this crate, internal and external, in place and properly secured, the insulators are all fixed for a trip to any part of the world.

When we come to pack objects of curious shapes, the most natural thing to do, once we have visualized the problem that they present, would doubtless be to employ a specially shaped box that shall more or less conform to their outline. But if we do this without further thought we shall get ourselves in trouble. Ocean freight rates depend upon space occupied as well as upon weight; and if we turn over to the steamship a lot of oddly shaped containers that cannot be economically stored away, we shall have our carelessness reflected on our freight bill in short order. Nevertheless, if it is possible to ship trick articles in cubic boxes, if we make them of such shape that their packing space and dimensions will fit together well, the owner has known as well as the customer that hereafter can be then packed in regular; and the shipper of automobile tires knows it too. The next picture illustrates the method.

When the method that has been so successful in the manufacture of automobiles is applied to the marketing of laundry. The reference letters are explained in the text

hand is indeed a problem for the packer. When he assembles six of them in the fashion shown, however, with proper packing to hold them in their crate with out slipping, the difficulties of making a square package out of a tapering circular one disappear immediately. Simple as all these boxes are when we have once seen them, their simplicity is really much like that of the egg trick that helped to make Columbus famous, and their development required no little exercise of the inventive faculty.

Marking Laundry by Machine

THE mechanical marking room of one of San Francisco's large laundries, equally designed and well-stocked, is the most mechanical marking room in the world. This is because it has specially designed conveyor which convey the bundles to the operator, and also conveyors which convey the goods from the operator to the classification room.

The bundles are opened by the operator shown in our photograph at *A*. He stands at the desk at the end of one of the conveyors, which delivers the bundles to him. His duty is to break the bundle, write the mark on the list, and keep a record of all marks given out, so as to prevent duplicate marks. The laundry list is then put back in the bundle, and the bundle placed on the conveyor as shown at *C*, the bundles being conveyed toward the markers in the laundry, giving the markers an even distribution of work.

The conveyor *B*, is provided with a special device shown at *K* and called a limit switch, which provides an automatic method of stopping and starting the conveyor. When the bundle of clothes on the conveyor travels to a point where it comes in contact with the limit switch, *K*, the electric motor that drives the conveyor is automatically stopped, and as soon as the marker removes the bundle that is in contact with this switch, the motor automatically starts up and drives the conveyor until another bundle comes in contact

with the limit switch when the conveyor will again be stopped.

The following shows the steps through which the clothes are carried in this mechanical marking room. The marker in the booth removes a bundle of clothes from the traveling conveyor and puts it in his work box, finds the laundry list which has the mark thereon, and sets the mark on her machine. This machine has a keyboard like an adding machine or typewriter.

All articles in the bundle are marked in the laundry list by the marker shown at *B*. The marker picks up the first article on the top of the bundle with the right hand and "commits" it with the left hand. If it is a shirt the marker presses on the shirt key on the counting device, shown at *H*, marks the shirt and throws same to the take-off conveyor on her right, which is shown at *G*, this conveyor delivering the goods to the classification room, from which point the goods are delivered to the washing machines.

When the marker finishes counting and marking the bundle in the manner just described, she lays the laundry list on the table of the counting device and lifts the table of the counting device to contact with the type and the count is transferred from the machine to the laundry list. This counting device adds up the number of each article, something like the ordinary adding machine, relieving the marker of this work.

All articles in the bundle are handled in this manner, with the exception of the knit goods, table linen and dark colored goods, on which an ink mark will not hold, or which it is not desirable to mark with an ink mark. Goods of this class are laid on the top shelf—running the full length of the booths, at the left and shown at *J*. An operator takes these goods from this shelf and takes them to the machine shown at *K*. She sews a patch on each piece of goods with this machine then puts the proper laundry mark on the second patch with the power marking machine shown at *M*. By combining these various conveyors with the marking and counting devices, a great improvement has been made over the method previously employed, under which all marking of the laundry and all counting of the various pieces and marking same on the laundry list was done by hand, with the aid of a single conveyor. The laundry industry ranks high in the application of labor-saving devices.

Finland Hydroelectric Plant

FINLAND'S largest hydroelectric power station, the most important of the Yvaakem Rapids, is well under way. The total head is to be built in four steps, the second being now under construction. When the plan is fully realized there will be a yield of 802,000 turbine horsepower, with a possibility of increasing it to 680,000 horsepower through controlling the waste level of the main lake.



When the method that has been so successful in the manufacture of automobiles is applied to the marketing of laundry. The reference letters are explained in the text

Women on the Farm

The Role in Our National Life of the Wives and Daughters of Agriculture

By George H. Dacy

DESPITE the census classifies farm women under the heading "no occupation," these rural housewives are among the busiest employed in direct agricultural activities or related lines of work. Daily their work begins just an hour or so after daylight—during the summer even earlier—while their husband and one task usually engage their attention until after everyone else around the farm house has gone to bed. No one has any real of "farm lands" or "country" honors being bestowed upon farm women yet these patient, persistent and plucky toilers deserve the highest awards which can be granted to womanhood.

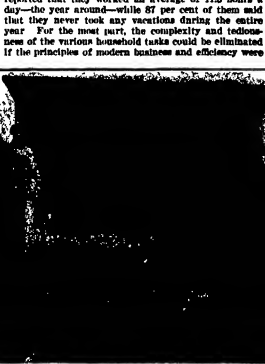
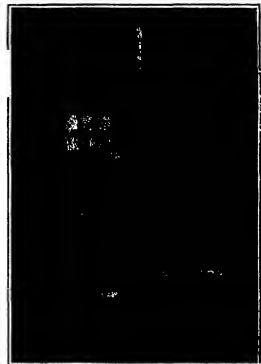
Heretofore, little attention has been accorded the conditions, environments, equipment and facilities under and with which the farm women of this country work. In fact the first detailed and authentic information along these lines obtained from a recent scientific survey which has been conducted by the national Department of Agriculture. In cooperation with the state agricultural colleges and the county demonstration agents, Uncle Sam has attempted to learn first-hand

wringers and like facilities on only one out of every 100 farms even has a mechanical washing machine. Usually she does the washing unaided either by hand or with primitive appliances.

Generally when breakfast is ready, she awakens the rest of the family, dresses several children for school and prepares their lunches. When everybody's appetite has been appeased, the housewife has to wash the dishes, feed the chickens, wash the milk pails and cans, and gather the vegetables from the garden during the summer or she has to carry them from the cellar during the winter for the subsequent meals. Then on all days except wash day, attention has to be devoted to the routine making of beds, filling and cleaning of lamps with kerosene and the tending to occupy all the extra time which she does not devote to these essential tasks. Then there are the other two meals to get, baking, sweeping and dusting as well as the marketing to take to all competing simultaneously with a couple of dozen other busy-up jobs for the time of the farmer's wife.

The national survey shows that 9000 of the farm women who were visited by Uncle Sam's representatives reported that they worked an average of 11.3 hours a day—the year around—while 87 per cent of them said that they never took any vacations during the entire year. For the most part, the complexity and tediousness of the various household tasks could be eliminated if the principles of modern business and efficiency were

applied. As matters stand, the waste of rural womanpower each year is stupendous. Women waste valuable time in drudgery when with the assistance of some of the modern machines, they could not only perform routine, menial labors much better and at less cost but they also would have more time to devote to the more important tasks connected with the successful operation of their homes. Expert, healthy, alert, hardworking and active housewives are the economic hubs around which the wheels of rural progress revolve. The government statistics indicate infallibly that if farm women—as a class—were permitted to exercise more brain power and less brawn in their daily activities, their innate ability—aided by efficient household appliances and



Left: Only one-tenth of one per cent of the farm women surveyed have hired help all the year around. Center: Eighty-one per cent of these women care for the poultry on their farms. Right: Showing the use of the kitchen cabinet and the kerosene burner. Sandy Mathen, a woman from one of the 10,044 typical farms.

Some of the results of the survey of the women on 10,044 typical farms

from the farm women, themselves, concerning the conditions under which they accomplish their daily duties. Complete records were received from 10,044 women who live in 55 different northern and western states. The data were gathered from carefully selected, typical farming communities in several of the leading agricultural counties of each of these states. Most of the localities covered contained from 85 to 50 farms and in the case of each section which was surveyed, a record was secured from every farm home in the neighborhood irrespective of the size of farm, character of tenancy, prosperity of the farm family or associated conditions.

This minute study of the daily duties of the average farm housewife shows that she plays many roles, from cook, seamstress, laundress and nurse to family purchasing agent, producer of dairy, garden and poultry products, teacher of her children and member of the local country club—if there are any. Her morning starts at five or six o'clock when she lights the kitchen range and begins preparations for breakfast. She draws the water for breakfast from a well or cistern located anywhere from 10 to 200 feet from the house—many of these sources of water supply being without pumps. On Mondays she beats the sun up and frays additional water to wash the family clothes. She is not aided by an electrically operated washing machine,

applied to the homely work of handling the farm house. If the general run of farm houses were as well equipped as the ordinary dairy barn with labor-saving appliances, the duties of the farm women would be materially reduced. Approximately 70 per cent of the farm homes reporting in this survey announced that they still used kerosene lamps—and these figures are probably quite accurate for the rural United States in its entirety. The installation of modern lighting systems would measurably lessen the toll of the farm wife and would make the rural home more cheerful and pleasant for the farm family.

There are some farm homes—but they are lamentably in the minority—whose quality as satisfactory and modern abodes and which eliminate the back-sore and drudgery from rural caligraphy and housekeeping pursuits. To a certain extent, a perceptible—although extremely minute—progress in increasing the standard of rural living is apparent in all sections of the country. Some homes in every community are divorced from the creature hardship to which the housewives have long been accustomed. The telephone and automobile largely have freed the farm families from isolation; rural disincorporation has lessened the problems of sanitation; community centers have been productive of increased sociability among country folk; while modern mechan-

modern methods of management—would enable them to do better work in less time than now is possible.

Seventy nine per cent of the farm homes in this country, at present, are yearning for modern lighting systems to replace the kerosene lamps now in use. Better lights mean a more cheerful home and operate directly for the education of the farm family as they would encourage more reading by the farm folks. Close to 86 per cent of the farm women not only have to start coal and wood fires each day during the cold period but they also have to carry the fuel and tend these fires during the day. Artificial lighting systems are not expensive; neither are heating systems and every farmer who hesitates to provide these conveniences not only is hampering the drudgery and housework burden of his wife but he also is paving the way for his children to migrate as soon as they are of age, from the farm to the city where the commodities are cheaper, where the wages are higher and where the opportunities for recreation, education and general development are more abundant.

Probably more than 80 per cent of the "isolated" farms in America are equipped with "less than" an artificial power pump, or refrigerator, or electric range, or electric lighting. (Continued on page 111)

A Dummy Aircraft Observer

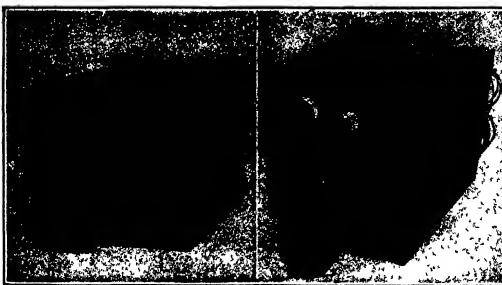
THE dummy watchman in a life over the field as a flight observer is common in the non-combatant areas, but for the first time a dummy observer is being employed on aircraft. The aeronautics instrument section of the Bureau of Standards, United States Department of Commerce, recently developed such a device for use by the Air Service of the War Department in performance tests during aircraft flights.

In testing an airplane it is essential to know the actual conditions that prevail during the performance flight. Therefore, a human observer notes the behavior of the air-going machine subject to test, but obvious data are limitations imposed upon the human eye in determining the action of the various instruments actually employed. Hence, the introduction of the dummy observer, which consists of a camera commonly used in the motion picture industry for photographing stills, is only the readings of a series of aircraft instruments recorded simultaneously on a film, but the inclusion of a clock among the recording apparatus makes possible the indication of the precise time at which the photographic exposure was made.

The motion-picture camera is directly driven by a small electric motor through a flexible shaft. It is placed opposite the instrument board in the fuselage of the airplane and is so directed as to photograph the electric motor, operated by means of a storage battery, is located within the reach of the pilot, whose command of the dummy observer is reduced to the simplicity of turning on and off a switch in the cockpit. As indicated by the photograph illustrating this article, the performance test instruments are compactly arranged in a wooden box, including an automatic timing control for the camera.

Preliminary tests of the dummy aircraft observer by the Air Service at McCook Field, Dayton, Ohio, involved the photographing continuously on a motion picture film atmospheric pressure exerted on the upper and lower surfaces of the wings of an airplane in flight. Measurements of these various pressures were recorded at the same time. The behavior of aircraft could thus be photographed in normal horizontal flight or in the course of turns, loops, spins, or other stunts in the air. In other words, this dummy observer visualizes on a film at specified intervals of time quite an array of performance test instruments.

When designing an airplane it has heretofore been extremely difficult to anticipate with any degree of accuracy the atmospheric pressures that the various parts may be expected to withstand. The aeronautics instrument section of the Bureau of Standards, in adapting the motion picture to the role of dummy observer, seems to have solved the problem. The pressure distribution exerted upon the horizontal surfaces of the tail-rudder, elevators, and stabilizers is obtained by connecting the atmospheric pressure instrument by means of tubing to the various points in question. The various instruments are calibrated in pounds to the square foot. The opposite sides of the diaphragm in these instruments are connected to the top and bottom, respectively, of the flask to be measured. Or, differently expressed, a simple flask indicated pressure in the bottom and section of the top would have the connecting switch integrated in the instrument. And, in this manner, the pressure



Two views of the dummy aircraft observer which records photographically the performance of an airplane or airship

manoeuvr test flight, the exposed film indicates the instrument reading, or the air pressure at a particular point during any flying stunt which the pilot desires to throw the spotlight of searching inquiry. According to the Bureau of Standards, this novel departure in registering instrument readings affords records that are more accurate than those obtainable by the conventional method.

The Latest Motion Picture Outfit for Amateurs

A N amateur motion picture outfit by which the amateur may take and project his own "movies" is the latest development of the leading American manufacturer of photographic apparatus. The C. E. Kenneths Moss, director of the Eastman Kodak Research Laboratories, in making the announcement recently at Franklin Institute, characterized this as the most important photographic achievement since the kodak and film photography.

The outfit consists of a "taking" camera and a projector, both of which are illustrated below. The distinctive camera weighs only seven pounds and is said to be, relatively at least, as simple in operation as the usual kodak.

The film for the new movie outfit is 1 1/16 inch wide as against the standard width of 1 1/2 inches, while each picture or frame measures one oval view by 3/16, as compared with the standard picture of 1 inch by 3/16. Five pictures on the small film consequently occupy the same length as two on the standard so that 100 feet of Cine Kodak film is equivalent to 200 feet of standard, and a 400-foot reel equivalent to the standard 100-foot reel. The film is of the non-inflammable type and coated with a special emulsion which enables the negative to be developed and then by a new process reversed to give a direct post

live picture for projection. The lens is an anastigmat working at f.8.8, permitting photographs to be made under poor light conditions. The finder is just above the lens and by a hinged act is instantly changed the position of its image as the lens is focused. In this way the image is shown through the center of the field at all times. The lens has a focusing lever carried through to the back which can be focused for any distance from infinity to four feet. The diaphragm control is in the left hand corner and can there be reset easily. In the center of the back is a footage indicator showing the quantity used, in feet. The crank turns nominally twice a second, taking pictures at the standard rate of 16 per second. The camera is daylight loading, the film being supplied in a special magazine. After exposure the film is removed in its magazine and sent to the laboratory for development.

The Kodascope, which projects the picture on the screen, is motor driven and is entirely self-contained in its operation. Once a film is placed in the magazine, the machine requires no further attention until the reel is exhausted. For home projection a lamp is used and the film is used the picture filling a 30 x 40 screen at a distance of 18 feet, and a 40 x 54 screen at 21 feet.

Why Is Tale?

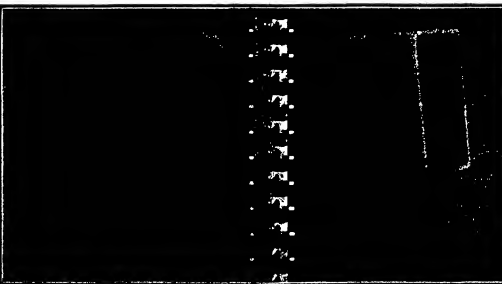
POOR talcum powder, of course. But that is by no means the only use for it, as you will find in this page—in the paper, as filling. More tale is used in filling the pores of print paper than in cementing good composites. Tale is used in filling the pores of paint. Its discovery for that use was hardly accidental, yet it was not originally added with the intention of improving the paint, but of saving the paint. It was found that paint chemists found it improved the paint for some purposes. Giltty consequences had been achieved in vain, but now added because a higher price had not been charged for the improved paint.

Talc is not at all rare. It occurs in many places, and the chief thing that goes to make up the value of it is caused by the preparation and marketing of the commodity. Found in its natural state it is a rock. Its chief physical characteristic is its waxy feeling. The mineralogist calls it steatite, and it is a hydrous magnesium silicate. About 60 per cent of the world's stock is produced in the United States, the supply being in Vermont, which is as close to the centers of the paper industry that tale from other regions

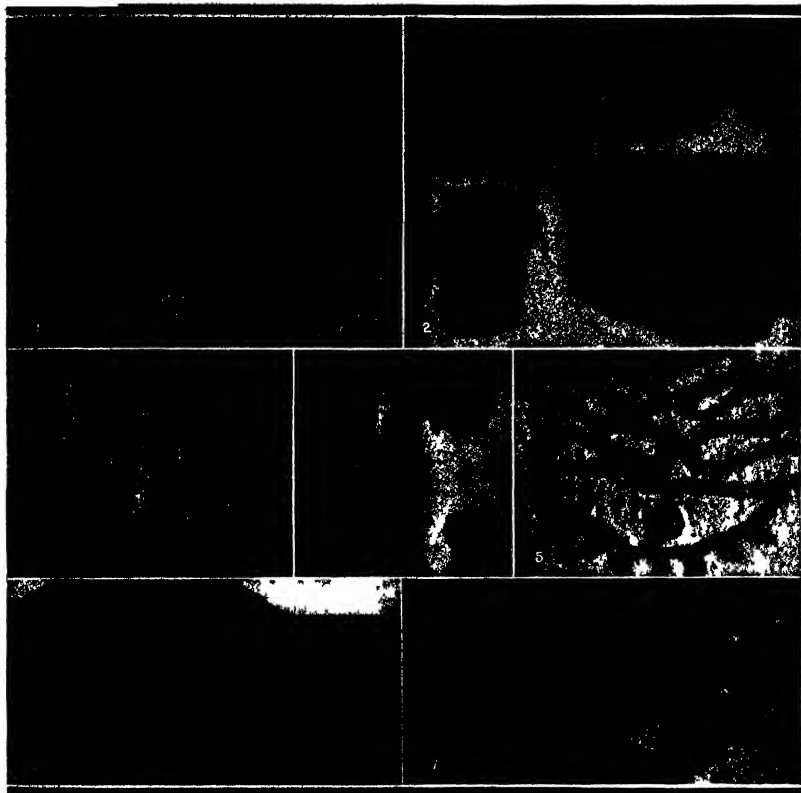
The best grade of tale is used for talcum powder, which must be white—except in the case of talcum for men, which has a flesh color.

Talcum powder that is directly harmful that is directly harmful. If earth is comminuted rock and if tale is a kind of rock, then talcum is only a kind of clean earth, to which boric acid is usually added to give something like effect. It is interesting to note how many kinds of rock when broken up and crushed to the finest kind of powder, have the general resemblance of talcum powder, although not the actual characteristics, which are necessary.

Not more than a generation ago, when the use of talcum powders became very general, it was said the skin of the growing generation would be ruined by its use. Yet the evidences of the use are otherwise. The processes the natural product go through before it is passed over the drugstore's counter insure that it is the cleanest of all dirt.



Projected home motion picture, the film shown actual size, and the camera set up ready for action



Figures, clockwise: "Walled-in" London House, and the British Museum.

THE excavations carried on this year by a joint expedition between the British Museum and the University Museum of Philadelphia under the leadership of Mr. C. L. Woolley, has resulted in the discovery of fragments of the ruins of the temple of the "Moon-God," which are most remarkable as showing a very highly developed civilization. Some of the remains date back 3000 B. C. The ancient city was 120 miles northwest of the Persian Gulf in the Kingdom of Elam, where it had been captured from the Sumerians during the World War, thus rendering exploration possible. The spot is marked on the map of the world, and some of the buildings, constructed in 1210 B. C., are nearly 1000 years before the time of Christ.

The picture of jewelry which we show (Figs. 2, 4 and 5) shows of much later date, are wonderful examples of the art of the period, and we may expect to find Chaldean

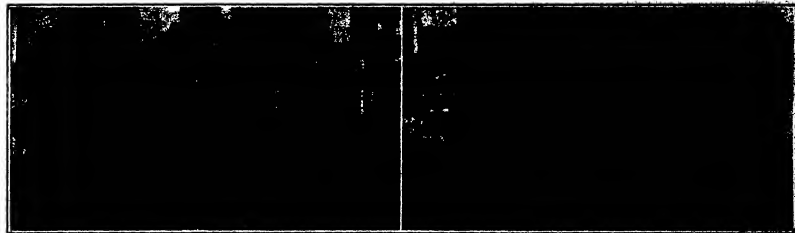
motives in jewelry the same as we now have Egyptian jewelry of modern fabrication.

Chemistry has proved to be an indispensable hand-maiden of archaeological research here for numerous inscribed tablets have been found but they were in bad condition and needed careful treatment before they could be read. They were of unglazed clay and consequently very liable to crumble to pieces. Mr. Woolley applied an elaborate method of baking and treating with preservatives so that the cuneiform inscriptions are now legible, as indicated in Figs. 1 and 2 showing the tablets before and after treatment. Most of those which have now been examined date from 2000 B. C. and relate largely to matters of money and accounts.

The explorations at Ur are particularly interesting because it was the birthplace of Abraham and therefore intimately linked up with early biblical history.

Abraham was born at Ur 2000 years B. C. and at that time Ur was situated in the Persian Gulf. But since that time the Euphrates has carried down enough silt to throw the ancient city far inland. It was a great maritime port and was a large commercial center. Besides, it was situated in a marvellously rich country. Chaldean was about the size of Scotland but the "Ships of Ur" navigated all the known world. Abraham was not a Jew by birth but was the son of Tzarah, an idolater. However Abraham was chosen as the fountain-head of a stream of descendants that has flowed on for 4000 years without a break. The story of Abraham in the Book of Genesis becomes very real in the light of the new discoveries. Abraham proceeded from Ur to Haran and from there to the land of Canaan. The bottom views, Figs. 6 and 7 show part of the excavation and one of the uncovered "walled-in" houses.

UR OF THE CHALDEES; THE BIRTHPLACE OF ABRAHAM



The laboratory for conducting cement tests

Where balloon fabric is tested by the Bureau

Uncle Sam's Question-and-Answer Office

The Bureau of Standards, and Its Bearing upon Everyman's Business Problems

By S. R. Winters

HOW can the dentist determine the wear and tear on false teeth, what amount of energy is absorbed by varying types of automobile tires, enumerate the different kinds of rare sugars, what temperature produces the strongest iron, how thick is molasses and what is the relation of density to quality, and how can a business man apply a motor-driven letter opener in speeding the clearance of his morning's mail?

No, this is not a list of conundrums for mere speculation or fictitious puzzles for firebrand fanatics. Rather, these were details problems explored and solved recently by the National Bureau of Standards—and these are only six of 254,000 tests by actual count, more or less satisfactorily conducted during one year. By classification, 110,468 scientific observations were made for the government and 14,200 for the public. The preeminence of the demands for Uncle Sam was partially attributable to the exigencies of war. For instance, it was imperative to develop a sound ranging device for the location of a three-inch battery, three miles away, accurate enough to fire civilian problems could wait solution.

Now the battle flags have been furled, the question arises how can the individual, the manufacturer, the business man, the inventor, the scientific society, public utility corporation, and the municipality avail themselves of the practical utilization of the Bureau of Standards in solving their knotty, every-day problems? Popularly termed, this government bureau is capable of applying the scientific and the theoretical to America's factories and its industries—with the ultimate results of eliminating waste, increasing production, increasing science, and obtaining high ability in products of industry by indicating an attainable standard of quality.

Perhaps millions of American citizens have never heard of this branch of the U. S. Department of Commerce—therefore, a paragraph as to its location and organizations is not amiss.

Not altogether dissimilar to the college that chooses rural scenes for its campus as a way of removing its students from the temptations of the white light of the city, the Bureau of Standards selected seclusion as a guarantor of freedom from mechanical disturbances and vibrations. Three and one-half miles from the White House, it is situated on a commanding (elevation 350 feet) from the Potomac River. It is reached by the Chevy Chase Lake car-line. Fourteen buildings, embracing 24 acres of ground, constitute its outward material equipment. The Bureau employs approximately 1000 persons, compared with 500 persons in the National Bureau of Standards.

Scientifically expressed, the Bureau of Standards classifies its function into twenty-four divisions. Standards of measurement, standard values of con-

stants, standards of quality, standards of mechanical performance and standards of practice. The public, however, can best visualize its capabilities and opportunities of service by briefly summarizing a few of its achievements in 1919.

States and municipalities can call upon the department to compare weights and measures. A revised edition of Circular No. 8, "Design and Testing of Standard Mass," has been published. Investigations of mine scales are being conducted in the coal fields of Ohio, West Virginia and Kentucky. Seventy-eight different railroads, in 32 states, had their railroad-track scales tested. Standards of gas service were evolved for 15 cities.

Telephone service, the haphazard of utility commissions and public alike, is the object of extensive investigation. Street railways and electric lighting companies also bring their problems to Washington for solution. A three-wire power-distribution system was suggested and adopted by the street railway company of Wilmington, Del. Recently the Bureau was wrestling with the problem of corrosion of the lead cable sheaths of the electric company in St. Louis.

The Bureau of Standards has the only "altitude laboratory" constructed in the United States. The small room, with reinforced-concrete walls, is strong enough to withstand the pressure produced on the outside by exhausting the air within to a pressure as low as one-third atmosphere. Aviation engineers are here testing the units of mechanical operating under conditions permitting of careful scientific measure-

ments. A device has been developed for measuring the rate of altitude on an airplane.

The Medical Service of the War Department and the general public are using 90 so-called rare sugars. The Bureau is conducting investigations that will ultimately disclose scientific data on the rare sugar.

A controversy has arisen between buyer and seller of blackstrap molasses relative to the quality of same—the Bureau of Standards has committed to set as referee. A device for determining the density of molasses has been developed—the value of the product being predicted upon its stickiness.

Hitherto the United States has imported its clay products from foreign countries. Cooperating with a pottery association in Blue-Liverpool, Ohio, the Bureau has completed satisfactory tests whereby white-ware pottery can be made altogether from American clays under commercial conditions. Of 46 compositions, more than half proved to be satisfactory and the American housewife can use tableware made from domestic clay. Optical glass, formerly imported from France, Germany and England, is to be manufactured on a commercial scale in this country—thanks to the efforts of the Pittsburgh laboratory of the Bureau of Standards.

Mr. Business Man, is your mail so heavy as to warrant the use of a motor-driven letter-opener? If so, write the Bureau of Standards, Pierce Mill Road, Washington, D. C., and inquire about the ingenious instrument which saves the time of an employee previously wasted in this task. New machines are vividly analyzed in this manner. The photographic reference record of incoming letters, by means of a projector, is adapted to flash the time.

Dr. George Kimball Burgess has been appointed director of the Bureau of Standards, United States Department of Commerce, succeeding Dr. A. W. Stratton, who resigned the directorship to become president of the Massachusetts Institute of Technology. The new director has been identified with the Bureau of Standards for 20 years, and since 1913 has served as Chief of the Metallurgical Division.

High temperature measurements in the outstanding scientific contribution of Dr. Burgess, he being the author and translator of a number of books on this subject.

His supervisory skill, organization and leadership is responsible for the present Division of Metallurgy at the Bureau of Standards, which has a staff of 15 persons. The newly installed director of this branch of the government service personally received the new model and the Bureau of Standards was the recipient of the gold medal from the Pittsburgh-Pottery Association. The new machine is the Division of Metallurgy range from the gaging, melting and casting up to the standardizing and measuring of metal.



Strains by twenty-four inch rollers used in the metallurgical division, for studying the effects of mechanical working upon metals

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News

Gravitation Truly Constant

MORE than one investigator has been led to the conclusion that the Newtonian constant of gravitation changes slightly as the attracting bodies are heated. In the Proceedings of the Royal Society for October 2, 1922, Messrs. P. R. Shaw and N. Davy, who had previously noted an increase of gravity with rise in temperature, now report that with improved suspension arrangements the difference disappears. This probably has a wider significance than would appear from its mere application in correction of the authors' previous results. The *Scientific American* has always expressed the opinion that observed variations of the gravitational constant as a function of temperature, or pressure, or of the chemical constitution of the gravitating bodies, have been due to observational errors or inadequate data.

The One-Hand Grease-Gun

LUBRICATING with the automobile with *one hand* is the latest thing, made possible by use of the grease-gun illustrated herewith. "A ton of pressure" is the manufacturer's claim, but he does



Reducing the grease-gun to its simplest terms

not specify whether he means total or per square inch. We assume that he means the latter, and that the true content of the claim will be duly apparent to all essential details. The checking of the accuracy of the calculations by the test of constancy of the energy of the system, commonly used in the astronomical case, would here have involved the extremely laborious calculation of the coefficients of the various periodic terms of the Fourier expansions of the kinetic and potential energies. A much easier method was furnished by the fact that in motion under the inverse square law the average absolute value of the potential energy is twice the average kinetic energy. Since the average value is simply the constant part of the Fourier expansion, and since a power series development is unique, the coefficients of like powers of the parameter must be identical if the computations are correct. There is absolute agreement in the first three terms, while the small errors in the fifth decimal place in later terms are insignificant, and due mostly to

Making the Chauffeur's Cigar Harmless

WE once brought down wrath upon our head by suggesting that a cigar lighter on the dashboard of the modern automobile was not enough of an absolute necessity to justify the car manufacturer in setting it down as one of the major sales points of his latest model. The reaction of the manufacturer of the lighter was substantially to the effect that we were the only automobile owner in the world who did not smoke, and that our viewpoint was accordingly a drastically distorted one. So we illustrate with studiously neutral comment the device that makes it possible for the chauffeur to smoke without putting out the eyes of his passengers. No, on further consideration, we withdraw this neutrality in favor of emphatic endorsement, for we have driven 300 miles behind a persistent smoker, and arrived slightly at the destination. The device illustrated consists of a gaseous cylinder that is fitted about the cigar, and prevents smoke and sparks from flying about. In all seriousness, it strikes us as a highly sensible scheme.



Safety for the person who has to ride with a smoker is secured by this gaseous cage for the cigar

The speedometer that acts as a governor

SOMETHING New in Speedometers. POSSIBILITY of improvement in the *speedometer* has perhaps not impressed itself upon the average driver, but the product need being marketed by a Chicago firm indicates that this possibility exists. As far as the mechanical indicating aspect, trip mileage and total mileage is concerned, this speedometer is no different from its predecessors. But it goes far beyond that.

The dial at the bottom of the instrument may be set for any desired speed, and then locked or left unlocked. In either event, as the car comes within two or three miles of the indicated speed, the signal light at the right will flash; and if the acceleration then continues until the car actually reaches the desired speed, the ignition is cut off. If the dial has been locked, there is no escape from this; if it has been left unlocked, the driver may meet an emergency by a simple twist of the key, setting the limit forward to any desired point. Finally, the instrument may be adjusted so that the signal light alone works, without the ignition cut-out; or the cut-out alone, without the light, or both together, as described above. Ordinarily, when the ignition cut-out functions, the engine will stop dead and stay dead until the car comes fully below the desired figure, and at this point the cut-out will go out of action and the rolling car will start the engine, just as it does in backing with the engine. If it is desired to prevent this, the dial may be left unlocked, and turned back to zero as the car out-crops into action.

This suggests a further use of the apparatus as a preventive of theft. Obviously if the dial be set to zero and locked, the cut-out cannot continue in action and no spark can be obtained until the dial has been unlocked or the wiring tampered with.



The speedometer that acts as the governor

The Normal Helium Atom and the Quantum Theory

AFTER a brief critical survey of existing quantum theory models of matter, a study was made by J. Van Vleck, in the *Philosophical Magazine* for November, 1922, of the model proposed by Kramers, *Zeitschrift für Physik*, No. 1080, 1921, in which the two electrons are arranged with axial symmetry, the symmetrical type of which the energy had not been computed. The mathematical analysis, necessarily laborious, was rendered greater than in the case of an astronomical orbit, owing to the relatively large perturbing forces of each electron upon the orbit of the other. It occupied about six months and is reproduced in all essential details. The checking of the accuracy of the calculations by the test of constancy of the energy of the system, commonly used in the astronomical case, would here have involved the extremely laborious calculation of the coefficients of the various periodic terms of the Fourier expansions of the kinetic and potential energies. A much easier method was furnished by the fact that in motion under the inverse square law the average absolute value of the potential energy is twice the average kinetic energy. Since the average value is simply the constant part of the Fourier expansion, and since a power series development is unique, the coefficients of like powers of the parameter must be identical if the computations are correct. There is absolute agreement in the first three terms, while the small errors in the fifth decimal place in later terms are insignificant, and due mostly to

neglect of the third and higher powers of the perturbations. The model is a set of hybrid of the Bohr and Langmuir models. It may be approximately described as the projection of a sine curve on a horn-shaped surface of revolution, the two electrodes always being on opposite sides of the barrel.

The unusual stability of helium indicates a very simple and symmetrical arrangement of its pair of electrons, but all the models possessing this property now appear to have been tried and found wanting. A reformulation of the quantum condition in one alternative and the author considers several of such. But he finds such one precluded by incompatibility with experimental results. A. H. Compton (*Science Abstracts*, 1908, 1921) concludes that the spiral tracks of beta particles indicate the field of an electron not having the superficial asymmetry required by Coulomb's law, and he suggests the beta particle acting as a magnetic doublet as well as an electric charge, but if the helium electrons did so act, their strength, to reconcile the calculated ionization potential of the molecule, would be quite incompatible with observed magnetic moment and would invalidate the classical theory of electricity. It is interesting to note that Kramers (*Science Abstracts*, 1920, 1922) suggest that some modification of the law of force at very small distances, either between two negative electrons or an electron and a nucleus, appears to be demanded by their experiments in the scattering of beta particles.

The Cap that Can't Lose Itself

THEIR proverbial collar button may still take first prize as a champion for losing itself under the drowsy, but the cap of the tube of shaving cream has made a rival record as one of "this little irritation" by its disappearance.



The cap that is bound to stay with its tube

A Giant Condenser

SO far as is known, the stage-built Sola condenser illustrated herewith is the largest in the world. It has just been completed by the manufacturer for use in one of the Government radio stations. It has a capacity of 6000 microfarads at 50,000 volts with 1000 lbs. It is of the oil-immersion type. The top insulator is of porcelain and the high tension terminal projects from the center.

CHANCEMAN, if this general type have been made by this New York concern for some time but the one shown is the first of its size to be manufactured. Similar condensers will shortly be in extensive use in connection with power factor correction for lightning protection and for other uses. Recent reports are that the installation of this one condenser has increased the station efficiency by 10 per cent.

By way of comparison the gentleman standing at the condenser holds in his hand one of the mine company's condensers as ordinarily employed in radio receiving. As may well be imagined the enormous difference in size introduces manufacturing problems that are by no means easy to meet.

A nice condenser for radio work, of huge proportions

down the lantern, until Man had devised something better to save his lamp and the result is that the main feature of one brand of this daily toilet necessity has put it into a tube whose screw cap is blinged as well. You can't lose it unless you mislay the entire tube. For further convenience the cap is designed so that it may be hung upon the wall by a little screw hook which accompanies it.

The Lightning Change Screw-driver

THE question of having the right tool at the right time has been partially solved by a western manufacturer who has produced the very ingenious means also a screwdriver illustrated.

It is absolutely a new idea and a departure from the usual magnetic screw driver in that the blade issues from the chuck into the working position without leaving the magazine. It contains three states of blades that are designed to give it a wide range of use. The blades are always contained within the magazine and are not removed consequently they are not lost or misplaced as is the case with most magnetic screwdrivers.

The basic principle of this new tool is that the blades are selected and loaded by gravity by tipping the tool. The blades are indexed to correspond with numbers on the shell and the operator is always sure of getting the right blade by simply holding the desired number up when tipping the tool as indicated in the illustration.

This new tool will be found useful by mechanics, mobilists, carpenters, sportsmen, electricians, automobile owners and in fact anyone who ever uses a screwdriver.



Magnetic screwdriver with a foot-pedal gear-shift

Can-Openers of the Month

TRADITION has the lock not and the important map as constituting the most fruitful field for invention when measured in more numbers of patents. We have expressed at one time or another a suspicion that the monkey wrench and the combination utility tool were low competitors and it just dawned upon us that another implement in which the scope afforded to ingenuity practically without limit is the can opener. We illustrate the result with two examples.

One of these at the expense of a little more cost than is usually taken up by the can opener does what we have not seen do before—it actually holds the can while it opens it. This in a way supercedes the safety can opener, because



The non-slip can-opener

the only reason why the average housewife cuts her foot on the can is that the latter slips in her hand. In addition this opener cuts the whole top off clean leaving a smoothly turned edge. A left hand turn of the crank opens the machine for insertion of a can and a right hand turn performs the deceptively simple. The apparatus occupies space—but no more than the less-used meat chopper.

For cans of fluid every user knows that actually removing the top is unnecessary. That two holes punched in the top are for the entrance of air and one for the exit of the contents, are quite sufficient. With special reference to canned milk we are now offered a simple device for punching the two holes at the most advantageous spacing.

An Outside Micrometer with No Moving Parts

THE latest micrometer instrument is of a steel tape design. It measures diameters from $\frac{1}{8}$ to 5 inches by thor-

sandth of an inch. It does the work of a micrometer caliper, though instead of reading decimals, it gives direct reading in thousands and fractions thereof. For instance if an article should measure .81175 by the micrometer caliper this instrument will give a direct reading of 8117.5 plus five thousandths. The graduations are quite legible as they are about one-eighth of an inch apart. This is possible, because while they represent diameter measurements they stand on the circumference and hence are more than three times as far apart as the corresponding marks on an ordinary straight rule would be. The tape is wrapped tightly around the object with the two scales shutting each other. The one piece construction eliminates faulty adjustments. Being so compact it may be easily carried in the kit or pocket, and requires no adjustment in use.



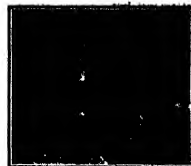
The easiest way to get into a milk can

Plating with Cobalt

PROBABLY the newest development in electroplating is the deposition of cobalt. Recently announcement was made of the discovery of a new process for electroplating with chromium, but the cobalt development is still more recent. A few years ago some Canadian research workers in the Canadian Department for Mines created considerable interest by putting forward a proposal to use cobalt as a metal for electroplating in the place of nickel. The results of these researches showed that cobalt could be deposited on brass, iron, steel, copper, tin, German silver, lead and Britannia metal and that the deposits were firm, adherent, hard and uniform and could be readily polished to a satisfactorily finished surface. The cobalt deposited was harder than the nickel and the speed of deposition considerably greater. It was also claimed that its resistance to corrosion was definitely superior to that of nickel, and that the deposits stood satisfactorily all the usual bending, hammering and bending tests. The actual weight of cobalt required for a good coating was stated to be about a quarter that of nickel. It is possible in electroplating with cobalt quite satisfactorily and very rapidly but it is unlikely that cobalt will ever attain the industrial importance of nickel.

Better Picture Frames Through a New View

THE very old-fashioned picture frames may have passed away, but there are thousands of smaller frames being sold to the hundreds of the old style frames. In art shops the making of picture frames is a large part of the business and the frames going through are ranging in size from those to carry post cards and smaller notions to those that are several feet in each dimension, and the molding used varies from a fraction of an inch in thickness to several inches. The volume of the business requires maximum speed, especially since



New and ingenious idea in the micrometer field

the price does not justify high costs. In nailing the smaller moldings there is more danger of ruining the job or putting the corners together in unsatisfactory way than there is in making the frames of the larger molding.

During the war one art dealer had to use so many green employees that he invented a special vice that enabled a green girl with little practice in driving a nail to turn out in a half day more work than several experienced men would complete in a day and do the work more satisfactorily. He realized that the danger point was in driving the nails for the corners so his vice was arranged to handle that part of the work.

A set screw in the standard brings the under gripper of the vice to a position where by stepping on the pedal the frame is held between this gripper and the two rests with the angle of the frame open for nailing operations. Some of the advantages of the vice as proved by the inventor's experience are that the frame is held rigid and the operator has both hands free thus removing the necessity for nail setters. Nor are there holes to drill. No operations for the pedal are necessary the feet performing the operations that grab the frame. Crowning one of the "niceties" phases of frame-making, is easily done without turning the frame. Small frames as well as large ones and small molding as well as molding two inches wide can be handled. It has helped this dealer to get frames on the market to meet a popular price demand.



The newest and best way in nailing picture frames



Small electric drill of extreme sensitivity

Electric Drills and Utility Tools

THE range of electric drilling and general utility tools is amply demonstrated by the two units which are illustrated at the top and bottom of this column. At the top is a machine designed to fill the demand for a bench drill, that could be depended upon for absolute accuracy and extreme sensitivity. At the same time it is adaptable enough to be used on many kinds of work. The motor is dynamically balanced, and runs equally on direct or alternating current. A ball thrust bearing takes up all end play, and wicked ground cups insure positive lubrication. Perfect concentricity in the drill is had by carefully grinding the gripping joints of the chuck jaws. Quiet-working locking devices make the raising and lowering of the motor or work-table a simple operation. The work-table is re-adjustable, and is operated and easily controlled by the operator's hand. A depth gauge regulated by a thumb-screw prevents the drill's going too deep. The balance of the table and its gearing is such as to bring drill breakage to a minimum with the smallest and most delicate drills. "Perfect control, ease of operation, and unusual adaptability" are the claims made for this machine, apparently with good reason.

The general utility tool illustrated below is produced by the same manufacturer. The motor speed is reduced through a worm-and-gear drive that assures ample torque. Particular attention is called to the hand piece, fitted with a double-row ball-bearing that takes up all thrust and radial load. The chuck will hold tools from one-eighth inch down to No. 40 drill. Its speed is from 600 to 2000 revolutions per minute, controlled by a sliding speed collar. The chuck guard, which permits gripping the hand-piece close to the work, can be removed with a single twist. Together, this tool seems a fair match for its brother in efficiency and all around adaptability.



The universal grip-of-all-tools

Better Tire Chains for Next Winter

AMONG the things that every automobilist knows are the comparatively short life of the cross links of anti-slip chains, and the manufacturing action of the clips that hold the side chains together. Especially if one is obliged to drive over alternating stretches of country road and concrete, the former being in such shape as to dent the chains while the latter is so constantly clear, one finds that the chains do not stand the test. Replaceable cross links, while conserving the constant use side chains, are really a begging of the question. And who has not had to stop in the middle of a winter day to mend the axle, about which it has been permitted to fall and catch itself by the opening of one of the clips?



New style of cross link that gives longer life to tire chains

We illustrate herewith the latest device of which the makers are over-pleased. These drawbacks. The new style of link should be a far greater amount of metal to the road at a given moment and hence should last far longer. And the new clip not only closes and locks more positively than its predecessor, it also makes it easier to bring together within clipping distance the two ends of a chain that is just a finger's breadth too short to go around the tire easily. This latter advantage, however, is a collateral one beside the positive locking feature, it will be plain that the clip actually hooks around itself, instead of depending upon some surface friction or spring action to hold it closed.

Motion of a Sphere in a Rotating Liquid

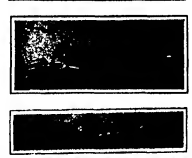
ASPHERE of uniform density is supposed to be suspended in a uniformly rotating liquid of the same density. An initial relative motion of the sphere parallel to the axis of rotation is set up by an instantaneous impulse sufficient only to effect a small disturbance in the motion of the system, small motion being defined to be such that the square and products of velocity and vorticity components may be neglected in the expressions for acceleration. The initial disturbed motion of the liquid will then be irrotational, since the effects of rotation take time to develop. Now the present intensity of the liquid consists of two parts, one depending only on the distance from the axis, and the other on the disturbed motion. When the disturbance causes the sphere to move parallel to the axis of rotation, the disturbed motion of the liquid will continue symmetrical about a line through the center of the sphere parallel to this axis, and the motion, pressure of the liquid will also be symmetrical about this axis. The pressure on the sphere will, therefore, be to produce an acceleration parallel to the axis of rotation, causing the sphere to continue its motion parallel to the axis of rotation, and its line of relative motion

may be called the axis of the sphere.

It is found most convenient to assume the existence of this particular type of motion, and then to show that all the conditions can be satisfied by making it a particular function of the time, a perfectly definite mathematical problem, the solution of which gives the following results. The sphere oscillates about a point on its axis, the distance of which from the initial position of the center of the sphere is proportional to the velocity of projection, the amplitude of oscillations rapidly approaches zero, but the period approaches a constant value half that of the undisturbed rotation of the liquid. A general expression is obtained for the velocity, at any point, reducing to simple exponential in particular cases, which are examined in the paper. It appears, however, that the gradients of the velocity of the liquid over the equatorial plane of the sphere and of the transverse velocity along a meridian of the sphere ultimately increase without limit, a stage being reached after which vorticity components cannot be considered small, so that the solution will represent the true state of the liquid only for a limited time. The question of ultimate physical state thus remains unanswered. J. P. Freudenstein has shown that a small steady disturbance is impossible, but if J. Taylor obtained a solution of the general question of steady small motions about a sphere, it would not satisfy the equations of small motion.—*Science Abstracts*, 428, 1908, based on paper by J. P. Freudenstein, *Proceedings of the Royal Society*, 101, page 88 111

Research on Edible Gelatin

ANNOUNCEMENT is made of the establishment of a Fellowship in the Motion Picture Industry by the University of Pittsburgh.



Partly open, open and closed positions of the new chain clip that hooks positively instead of depending upon friction to keep it closed

for the purpose of ascertaining the real food value of edible gelatin in its manifold applications in the American dietary.

The founding of this Fellowship is the outgrowth of the desire of the gelatin manufacturers to uphold high standards in the manufacture of this food and to have available for their own use and for the trade data of scientific and technical nature respecting the advanced new in the food industries.

In addition to experimental investigations, a correlation of all available facts regarding edible gelatin will be made, to be held at the disposal of all persons desirous of using the product. The present incumbent of the Industrial Fellowship is Dr. Thomas H. Downes, who is glad to furnish any available information to those interested in the uses of edible gelatin.



The newest substitute for the hose reel

Exit the Hose-Reel

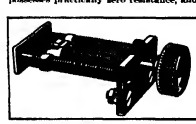
SOMETHING far simpler than the hose reel is offered the amateur gardener in the city illustrated herewith. For moderate lengths of hose, much less space is required by a hose hooped on itself once like a hoop fastened by the clip, and hung on a peg, than by one revolved up in the old fashioned manner.

Periodic Annual Variation in Pendulum Rate

COMPTON PENDULUM RATE, page 748, gives an account by R. Godey of observations on a pendulum in the Foucault Observatory. This pendulum is in a ground floor room enclosed in a double plane case, so that the temperature varies slowly. By variations of atmospheric pressure are felt. It appears that each year this pendulum runs slow beginning about April 1, that from that date until September 11 there is a series of rather indefinite fluctuations, and that, subsequently, the pendulum moves at its mean rate until near the end of the year. The ascertained have been established by curves plotted for twelve different years; they cannot be explained by changes either in temperature or in pressure, or as the result of chance. Whether they are a peculiarity of this pendulum, or may be looked for in other instruments, does not appear.

A More Sensitive Radio Rheostat

RECENTLY there was placed on the market a radio rheostat with greater automatic features than have been offered heretofore. It gives the most precise control of filament current, assumed as the range which is covered by three-quarters of a turn to three complete turns on most instruments, is here spread out over 40 full turns of the knob. This does away with all necessity for hair's breadth adjustments.



Radio resistance member that requires no minute adjustments

The Service of the Chemist

A Department Devoted to Progress and Achievement in the Field of Applied Chemistry

Conducted by IRMAH GUMBERG, Chemical Engineer

Electricity Is Generated From

A Dry Gasoline

A **DRY** gasoline is recovered from a **DRY** gas. It is a product, known as dry gas. Recently the Government announced that it had secured the services of the large operating companies of the mid-west to utilize the dry gas for the generation of electricity, which is now used in running the well pumps. The use of dry gas for this purpose is intended to reduce the cost of well operation as well as increase the output of the well.

New Paper Stock: Cypress Pine

THE **W**estern Australian Forest Products Laboratory has announced that the wood of the cypress pine, a tree which is indigenous to Queensland, is suited for the manufacturing of paper. The paper is brown in color and is claimed to be superior to that obtained from the hoop pine and silky oak, two recent developments brought forward by the same laboratory. In fact the cypress pine paper is said to be lighter, thicker and stronger than imported Kraft paper. It has also been found that the silky elm or brown oak of the coast forest is almost equal in value to the cypress pine.

Preservation of Fish Nets

A **C**CORDING to the United States Bureau of Fisheries the efficacious methods of preserving fish nets from rotting, tarring and encrusting. In the tanning method the nets are left soft and pliable. After the nets are dipped into the tan liquor it is well to give them a treatment with bleaches of potash, which increases the preservative power of the tanning materials, such as quercitron, catechu, gamboge, etc. Hemp threads are affected detrimentally in this way as well as cotton threads but not to so high a degree. Tarring the nets is the principal method used in the United States. It consists simply of passing the nets through hot tar, re-tying the excess tar and then drying. This is a very effective method as the tar is used in an anti-rotting and preservative. It is also used for preserving nets. It is a good preservative and causes little shrinkage. The price of tar is not so high as that it wastes out too readily, or evaporates from the net.

Gasoline From Coal

A **C**CORDING to experiments that have been made at Karlsruhe, Germany, the Germans have succeeded in making gasoline from coal. A report from the American Consular Service at Karlsruhe states that a plant has been established for making about 10 tons of gasoline daily from coal. The conversion of the coal into gasoline is accomplished by hydrogenating the coal, whereby the hydrogenated coal is changed into a gas. The gas is then passed through a series of distillations, the last of which is a final wash with water to free it of residual alcohol and fuel.

Boat Draining From Old Rubber

OLD rubber, waste and scrap, which may be used in a compound, developed as a boat draining and drying compound. The rubber is cut into small pieces and then heated in a large vat of water. The rubber is then washed and dried. The dried rubber is then used in a compound for boat draining and drying.

dation due to exposure to air, is used preferably as it produces a superior product. Old rubber, which contains such substances as zinc oxide, sulfate of barium, lampblack, etc., gives good results.

A thick, heavy liquid substance is produced by the fusion of which is no longer rubber but which is of very heavy consistency, highly adhesive, of a waterproofing nature and capable of adhering strongly to surfaces and of forming a frictional coating on them.

New Protective Agent for Animal Fibers

A **N**IMAL fibers, such as wool, silk and substances such as leather and skins are protected against the action of alkalies in their finishing and treatment processes by means of a product, known as Protosol, which is prepared from sulfuric acid and water. This represents just another way in which these liquids can be put to good use. For further information see the report referred to the *Deutsches Woolsteigewerbe*, Vol. 54, page 1061.

Making Artificial Egg Substance

A **S**UBSTITUTE for waste of eggs, according to a German process, which is patented in Germany Patent No. 442,806. The process is first to extract the yolk and lecithin from the egg, and then after the albumen has been removed by evaporation, the substances remaining are treated with a hydrating agent until they take on the color of egg yolk. This mass is then mixed with protein substances or the protein residues obtained in the extraction of the egg yolk. Palladium, precipitated or very finely pulverized in alcohol, is used as a catalyst in the hydration. About 40 kilograms of egg substitute can be obtained from 100 kilograms of codfish roe.

Durable Stain for Woodwork

A **N**EW German patent, which describes a process for making a durable stain for woodwork is as follows: A solution of one kilogram of commercial deep brown stain (Oxide brown, consisting chiefly of alkali humates) in 30 to 40 parts of water is stirred and heated to boiling, and about five liters of a two per cent solution of ferric chloride are stirred in. In a thin stream, until the mixture will filter easily and the filtrate shows an excess of iron. After decanting as much of the liquor as possible the remainder is poured through a bag filter, and the solid residue is dried in a vacuum oven. The dried residue, when mixed with a little ammonia, forms a stain ready for use. This stain is applied to the wood, and on evaporation of the ammonia becomes insoluble in water. The composition of the compound is ferrous ammonium compound of ferric chloride.

Metal Linings by the Spray Process

THE **S**PRAY process for metal on surfaces in order to protect metal surfaces against corrosion is not a new process, but to the present time it has not been the most successful. The process has been improved by the use of a porous character, which is a decidedly undesirable property in resistant

linings for chemical apparatus. It is now claimed by the German company, known as Metallator A. G. of Altona, that thoroughly satisfactory tin, lead, aluminum and copper linings can be produced by spraying the sprayed metal coat to a finishing process, which may also be effected with some chemically resistant material, for example, in the case of lead lining with lead sulfate obtained by treating the lining with sulfuric acid. The great advantage of these sprayed linings over the usual cold-chamber lining is that the close contact with the underlying material, which is an important factor in apparatus with walls through which heat is to be transferred. —*Chemical Zeitung*, Jan. 11, 1923.

New Oil Seed From Gold Coast

THE **N**ew oil seed from the Gold Coast is now known as Klidwee can be used to good advantage as an oil for the manufacture of soap. The content is about 44.2 per cent of the entire weight of the nut. The fat could probably be used as food and in the manufacture of soap. The removal of the shell, which is thin and which forms only about 88 per cent of the weight of the nut, should not present any difficulty. The residual mass, after the extraction of the oil, possesses a bitter taste, but the tannin contained in it, and hence is unsuitable for cattle food. —*Bulletin Imperial Indus. XX*, No. 1923.

Building Stone From Castor Bean

I^N England a building stone for interior purposes is made from the residue that is recovered from the extraction of castor oil from the castor bean.

Asphalt Vapors a Mole Killer

THE **N**ew has been made in Germany to determine the effectiveness of asphalt fumes as a moth killer. The asphalt is vaporized by being heated in an enamel pot and the vapors are allowed to enter a well-constructed room, where they exert their destructive action on the moths.

Sulfur Dioxide from Sulfates

W^HEN alkaline salts, such as sulfate of magnesium, lime and strontium are mixed with iron and then heated to the proper temperature, the sulfate is decomposed by the iron with the evolution of sulfur dioxide gas. This reaction is generally carried out with the aid of carbon, and in this case, where iron supplements carbon, the reaction can be effected at a considerably lower temperature and also with a better yield of sulfur dioxide gas. This process is described in detail in the German publication entitled *Zeitschrift für angewandte Chemie*, volume 126, page 557-558.

Uses of Zinc Dust

A **N** interesting list of the uses of zinc dust in the powdered state is quoted in a recent issue of *Chemical and Metallurgical Engineering*, April 8, 1923. The chief properties for which zinc dust is used may be summarized as follows: (a) reducing properties, as in the dye industry, for reducing nitro compounds to organic amines and in preparing sodium hydrosulfite for the reduction of

vat colors, (b) the property of precipitating metals from their solutions, in particular for the precipitation of electrolysis or for the manufacture of lithopane (c) the property of reacting with dry oxygen at a high temperature and of giving with molten air a basic carbonate or with molten cupric oxide which protects the metal from further oxidation. These properties have led to its application in painting iron objects, sheathing (that is, immersing iron objects in zinc dust at a temperature of 500 degrees Centigrade), galvanizing out iron and metallization (that is, deposition by protection of a layer of zinc on the surface of a metal). Zinc dust is usually obtained as a by-product from zinc smelters, but it is also made by burning zinc against a stream of liquid zinc or by grinding. Such dusts vary widely in composition, some of which are undesirable for certain uses. Microscopic examination has shown that the grains of zinc dust consist of metallic globules coated with crystals of zinc oxide which prevent the globules from uniting.

The Use of Aluminum Vessels

A **C**CORDING to an article which has appeared in the *Zeitschrift für angewandte Chemie*, volume 61, number 20, aluminum vessels are which are undesirable for certain uses. Microscopic examination has shown that the grains of zinc dust consist of metallic globules coated with crystals of zinc oxide which prevent the globules from uniting.

Bio-Chemical Engineering

THE **C**ONVINCING proof is given in the *Zeitschrift für angewandte Chemie*, volume 61, number 20, that the economic utilization of alcohol and other forms of plant energy, may save the fuel for the production of electricity. The question whether the above would define a new profession of importance, it is not clear. It is, however, a question to play more and more a role in our chemical professions. The expansion of the sugar industry through attention to the intensive cultivation of the plant, and the suggestion that the Biologist, *Chemical and Metallurgical Engineering*, April 8, 1923. The economic utilization of alcohol and other forms of plant energy, may save the fuel for the production of electricity. The question whether the above would define a new profession of importance, it is not clear. It is, however, a question to play more and more a role in our chemical professions. The expansion of the sugar industry through attention to the intensive cultivation of the plant, and the suggestion that the Biologist, *Chemical and Metallurgical Engineering*, April 8, 1923.

The Heavens in August, 1923

Measuring the Minute Heat Radiations Received by the Earth from the Stars

By Professor Henry Norris Russell, Ph.D.

THE cold moonlight is a commingles of literature and with good reason. Though the rays of the sun are—and there's exhaust us according to the season—time of the sun in the eye is not the least effect upon its temperature sense. This is not so, because the heat radiation accompanies moonlight, but for the simple reason that the nerves of our eyes are exquisitely sensitive to light while those of our skin are but rudely so to heat. No artificial appliances can teach us to see with the eye in sensitivity to light—unless we make use of something like the photographic plate, which adds up the cumulative action of hours. But it is very easy to make heat detecting instruments (as in physics) as sensitive than our cutaneous sense. With such devices the heat not merely of the moon but of the stars can be detected and measured as accurately as we at the 11th and Lowell Observatories and as Ptolemy and Nichol have done more recently and in like manner at Mount Wilson.

The heat measuring device is very simple. It is built in appearance, and in theory. Two thin wires of different metal meet in a little disk blackened to absorb any radiation which falls a. In this junction is heated while the rest of the circuit of which it forms a part is unaffected. An electric current will be set up which can be registered by a sensitive galvanometer. Various metals differ in thermoelectric power, and by a suitable choice, such as making one wire of bismuth and the other of a bismuth tin alloy, the current can be increased. If the wire of the alloy is soldered to a bismuth wire at each end and first one junction and then the other is exposed to the source of heat, the current will flow in opposite directions and the observed effect will be doubled.

Theoretically then things are very simple, but to realize high sensitivity in practice is anything but easy. Since the heat of a star even though concentrated by the greatest telescope is very feeble the receiving disk and wires must be made as small and light as possible. In the apparatus used by Pettit and Nicholson the disk is about 1/80 of an inch in diameter and 1/8000 of an inch thick, while the wires or rather strips of metal which lead to it are 1/200 of an inch wide and 1/8000 of an inch thick. To assemble and mount so tiny and fragile an affair demands great manipulative skill.

The slightest breath of air blowing past the junctions would cool them more than a star could heat them. The whole apparatus is put in a glass tube exhausted to a very high vacuum. The window on this tube through which the starlight enters must not be made of glass but of fluorene or rock salt which unlike the ordinary type of glass are transparent to the long invisible rays as well as to the short ones that we call light.

How the Observations Are Made

All this care would be of no avail were not the electrical instruments equally sensitive. Here, fortunately, the astronomer has the advantage that sensitive galvanometers are used in many lines of scientific work, and can be obtained commercially. The deflections of the fine suspended magnet are read as usual by reflecting light from a mirror that turns with it. If the mirror is of very good quality, the scale can be placed as much as twenty feet away and good results still obtained. Such an instrument will give a deflection of two millimeters for a current of one millionth of a millionth part of a milliampere. This galvanometer is not set up in the dome but far below in the basement in a room where the temperature is constant. The wires connecting it with the receiver at the telescope, which must be about a hundred feet long, must themselves be very carefully insulated and shielded.

When all precautions have been taken and the apparatus is in good order, the astronomer now it a few days ago—it works like a charm. The hundred inch

telescope is set on the star and the observer looking through another disk at the back of the vacuum cell, sets it first upon one and then upon the other of the junctions. Meanwhile a second observer in the basement, connected with the first by telephone records the readings of the galvanometer.

In practice, this is done photographically on a plate moved slowly downward while the spot of light swings back and forth across it. It is extraordinary to realize that it shifts regularly back and forward as the star is set on one or the other of the two junctions and to realize that the energy which moves the image actually comes from the star. For in this case there is no terrestrial source of electromagnetic force set into action by a relay, the star's own heat supplies the power. Calculation shows that less than one fifty thousandth part of the heat received from the star is turned into electrical energy and this low efficiency is almost unavoidable for the rise in temperature of the heated junction is little over a tenth of a degree even for the brightest stars.

sort, and hardly one-fiftieth as much as a white star like Vega. This is true because the surface temperature must be much lower—perhaps 2400 degrees as against 8000 degrees for an ordinary red star like Antares.

This was shown by observations made by the Mount Wilson observers have recently found much more remarkable stars among the long period variables. Stars of this sort have maximum heat radiations as high as ordinary red stars. But near minimum, when their light may drop to less than one per cent of the maximum brightness, the heat radiation is only one-fiftieth of the maximum amount. Stars of this sort, invisible to the naked eye, may send us more heat than Vega. In certain instances the ratio of light and heat is something like one ten thousandth part of the value for a white star. This indicates relatively very low temperatures probably from 1200 to 1500 degrees Centigrade. We may look upon these variable stars, then, as bodies which periodically and for reasons still unknown cool down from the ordinary surface temperature—which begins where laboratory temperatures leave off—to temperatures such as are found in every foundry. At these lower temperatures practically all the radiation is in the long variable waves, the visible light forms but a negligible fraction of the whole.

Further work with this new and powerful instrument of research will tell us more regarding the temperature conditions of the stars and of the moon and planets too.

The Heavens

Turning to our usual star-gazing, we find Cygnus right overhead—the swan being fairly easy to locate in the north-northeast down the Milky Way, with his outstretched wings extending into the darker sky on each side. Along the galaxy to the northeast we find Cepheus, Cassiopeia and Perseus to the southwest, Aquila, Ophiuchus, Sagittarius and Scorpio (setting). Lyra is west of the zenith, with Hercules, Corona and Boötes below. Draco and Ursa Minor are above Ursa Major all well up in the north northwest. Pegasus is being in the east with Andromeda on the left, while Aquarius and Capricornus are in the dull southeastern sky above Pegasus.

The Planets

Mercury is in evening star this month, but is south of the sun and is easily seen in our latitude. Even at the end of August when he is low in the sky, he sets at 8° 30' M. and is deep in the twilight. Venus is a morning star but very close to the sun, and practically invisible. Mars too is behind the sun, and in conjunction with him on the 8th and 9th. Jupiter is in quadrature east of the sun, and after that is an evening star, but is visible until after 9 P. M. even at the month's end. Saturn, near about 30 degrees earlier, sets a few minutes past 9, setting before more than an hour before Jupiter. Uranus is approaching opposition, and is observable late in the evening. Neptune is in conjunction with the sun, and is invisible. The moon is in her last quarter at 2 P. M. on the 1st, and on the 2nd, she is in her first quarter at 1 A. M. on the 10th, and full at 9 A. M. on the 20th. She is nearest us on the 16th, and furthest away on the 2nd and 18th. On the 21st, she is in conjunction with the sun, and on the 22nd, she is in conjunction with Venus on the 11th. Mars and Neptune on the 13th, Mercury on the 19th, Saturn on the 21st, Jupiter on the 22nd, and Uranus on the 27th. On the morning of the 20th a partial lunar eclipse occurs. For an observer on the moon, the first crescent of the sun is seen at 11:30 A. M. on the 21st. This eclipse is visible at 8:15 A. M. by our eastern standard time. But little will be noticed by the average terrestrial observer until 4 M. on the 22nd. The sun is in conjunction with the sun on the 23rd, and on the 24th, she is in conjunction with the sun. The days take it slightly, only one-sixth of the distance being traversed at the maximum phase of 8° 40' A. M. on the 24th. This eclipse is visible on specially favorable occasions.

At 11 o'clock, Sept. 14
At 11:15 o'clock, Sept. 14
At 11:30 o'clock, Sept. 14

The hours given are Standard Time. When local standard time is in effect, they must be made one hour earlier in Eastern time.

NIGHT SKY: AUGUST AND SEPTEMBER

and for the average star is much less even than this. The heat measuring device, in its present perfection, adds a new and very important weapon to the armory of the astrophysicist, and we may expect to hear much of its results in the near future. To speak of but one thing now it is found that stars of different spectral types, that is of different temperatures give very different amounts of heat in proportion to their light. For the same brightness, as observed by the eye the hottest stars send us the least total heat and the coolest ones the most. This sounds very extraordinary until we turn the light around and say that, for equal amounts of total heat, the hottest stars give us the most light—when we recognize at once the factor of enormous efficiency familiar to everyone who understands why tungsten lamp which runs at a higher temperature than its carbon predecessors, sends him their lightning bolts.

What It All Means to the Astronomer

This idea will give us the means at our disposal of estimating the temperatures of the cooler stars. For example Alpha Herculis, a red star of what is called Class M, gives only about one-fiftieth as much light, in proportion to its heat, as most stars of its

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W PAGE, M. A. B.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles.

Stocking Crushed Stone

THIS accompanying photograph shows the method used in building high stock-piles of crushed stone for highway purposes on Illinois day-labor construction of pavement, under the supervision of the superintendent of construction, H. B. Jay. Three-ton-capacity dumping body trucks were employed to haul the aggregate from the railroad, and by use of portable runways or trucks up which the trucks ran and dumped their loads. The trucks were built to haul about 10 to 12 tons full. The runway sections were designed to be of such a weight that two men could handle units in placing them in position and taking them up and moving to other set-ups.

rial fittings where grease or solidified oil is to be delivered. A moment's work suffices to lubricate each part of the truck.

New Cushion Tire for Trucks

Announced the details of construction of its new "aircore" cushion tire for trucks. Produced in the full and double-cushioned types, the new tire is designed to provide displacement against located on both external and internal points to accommodate the flow of rubber when under pressure. The company, pointing out that the mold tire tends to bulge out at points in front of and at the rear of the area in contact with the road, as-

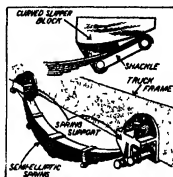
Variable Length Springs

In a rest spring truck the end of the elliptic rear springs have front and rear anchorages rendering them efficient and augmenting the carrying capacity and increasing the load and velocity of the rear spring. The design features of the rest spring are shown in the illustration of the rear spring. The rear of the rest normal design, are anchored to the truck plates as usual, though the plates project rearward at an angle of about 45 degrees from the vertical. The rest spring is attached to the truck plates as shown in a perpendicular illustration. Above each spring end the frame bracket has attached to its under flange a rest spring anchor. As the truck is loaded, as the spring becomes deflected with increased load, forms an abutment for the end of the top leaf, progressively shortening the effective length of the

The shackle plates merely serve to locate the springs for the latter come into contact with the slipper almost immediately the first portion of the load is put aboard. The slipper is separate from the actual bracket, being of cast-iron and having a pair of rollers which are provided for the contact surfaces of slipper and spring as well as for the shackle pins. At the front ends the slippers also appear, though the shackles are absent. The accompanying sketch shows the manner in which the load is loaded with quarter and half loads of merchandise, especially fragile goods, shows to greatest advantage in connection with passenger transport vehicles, which are loaded in a few minutes and are able to unload long and short.

A New Type of Rail Car

THE accompanying photograph shows a gasoline driven rail car recently delivered to the Hetch-Hetchy Railroad at Groveland, California. This car has



Details of the design by which the springs are automatically lengthened as the load increases

better traction secured by suspending the motor on coil springs direct over rear axle on one end of a sub-frame attached to the main frame.

The sub-frame makes one-half of a complete truck as it has a swivel bolster built in the main frame so that it will turn at curves, thus eliminating flange wear and relieving side thrust. It is said that the car rides as well in the rear seats as in the center. The car complete weighs but 10,400 pounds and makes eight miles per gallon of gasoline. The same principles may be used in construction of stages and omnibuses to run on the highways.

A Large Tractor Trailer Outfit

WHAT is regarded as the largest pressed-steel drop-frame semi-trailer that has ever been built is 48 feet long over all 8 feet wide and 12½ feet high from the ground to the top, and is built to conform with the State of Michigan's trailer law, the maximum



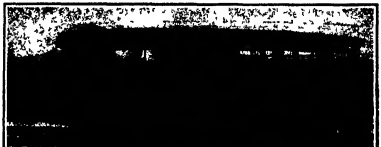
File of crushed stone, as ballit by dumping motor truck

units of 4x4 stringers to which were nailed two-inch planks, making the tracks slightly wider than the tires. On top of the plank 4x4 guide rails, or curbs, were bolted, so that the trucks would stay on the runways. Each ten-foot unit was attached to the next one by means of three-quarter-inch iron hooks and eyes, and fastened together laterally by the same method. All units were interchangeable.

The Lubrication Problem

MORE and more attention is being given to correct lubrication of motor vehicles, for it is realized that no class of machinery requires more thorough lubrication. Various systems for supplying oil and solidified oil to various parts of the motor truck have been introduced of late. The most popular is in the form of a modified grease gun which is provided with a flexible hose and coupler for attachment to the ap-

form of specially designed notches cut in the side walls and tread and the central hollow ring or core surrounding the base band of the tire, will take care of this "blowing" tendency. The notches not only furnish displacement space but also a sure-footed traction in all weathers. In order to prevent the accumulation of stones or caked mud in the notches or vents, petble ejectors, in the form of a step-like formation of rubber lugs, are provided in each notch.

[illegible]

Gasoline rail car with power plant at rear

many new and distinct features. It seats thirty passengers and is built for either narrow or broad gauge railroads. On the Hetch Hetchy Railroad it negotiates a five per cent grade, twelve miles long, with numerous 80 degree curves, at a speed of 27 miles per hour. The Hetch-Hetchy Railroad have been operating gasoline motor cars for the past six years and this car is said to be more efficient than any of their previous equipment.

By placing the motor rearwardly of the driving wheels all revolving parts in front of rear axle are eliminated, thereby permitting a very low hang car, and all motor noises and smoke or gasoline odors are at the rear. The passenger seating capacity has been increased without lengthening the wheel base and

limit of which is 60 feet. This trailer was designed to haul automobile chassis back from South Bend automobiles to North Bend, Indiana, and to bring trailers back from South Bend automobiles to the tip of the trip of the trailer. The trailer carries five large axles and on the rear turn tip brings back 24 open automobile bodies painted and upholstered. The largest freight-car can handle only from half to one ton of material per hour at a rate on this class of commodity substantially less than that of the trailer. To handle this trailer to handle 24 bodies for approximately one-half of what it would cost to haul them by rail. The bodies in this trailer are made of steel and are held in position by steel and wood frames so that they hang clear of the floor and do not rub or touch each other. They are spaced apart by about three feet from front to back, this makes



Showing how tracks are laid up the steep pile to provide a runway for the road construction truck.

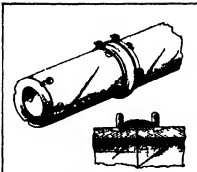


Fig 5: E. W. Higdon's invention gives a better sealed joint for pipe sections than heretofore.

Fig. 6: A new way of keeping the water separate from the cooling ice, patented by J. Harris and F. Borgstrom.

Fig. 7 More certain and effective operation is claimed for T. J. Cahill's new flush valve

Fig. 81 M. BATES invention comprising check-protective means embedded in the check and the check book and available for use at all times and places.

FAU—L. L. MOORE and F. W. RADCLIFFE 5863 No. New Hampshire St. Los Angeles 4 Calif. An object of the invention is to provide a tag for highly polished and delicate articles such as silverware and jewelry likely to be scratched by ordinary price tags. A further object is to provide a cloth covering, constituting a means for protecting the tag from engagement with articles to which it is to be attached.

(ONV) REPIBIL FURNITURE — Loma
HOLMES 277 Hallyr Ave. Macon Ga.
The invention particularly relates to a
kitchen cabinet. This object is to provide
a cabinet of artistic appearance and durable
service which will save much time and effort
for the storage of unprepared food and
cooking utensils and which may be quickly
converted into a table when desired.

PIPE JOINT — R. W. Henson 741
Patented At Atlanta Ga. The object of this invention is to provide means for connecting the meeting ends of a pair of terra cotta or similar pipe sections in such a manner that the sections are securely held in alignment. A further object is to provide a pipe joint which utilizes cement in a more or less semi fluid state to connect the sections and firmly hold the joining keys within the sockets or grooves provided for that purpose. (See Fig 5)

CUETIP FASTENER—H I. GENTNER
e/o Mrs Jacobs 141 Greenacre Ave Fair-
field Conn The invention pertains broadly
to billiard cues and more particularly to the
provision of fastening means for a cue at the
attachment of the kind comprising a tip and
backing element on which the tip is to be
secured Among the objects is to provide

flexible wire members embedded in the tip and passed through holes in the banking element which when screwed down on the arc will serve to finally clamp the tip.

CALENDRIAR—W H HANCOX, 1001 F St. N.E. New York Kan. An object of the invention is to provide a calendar which may be used for a period of 12 years or more. A further object is to provide means for bringing the various days and years into registration with an opening so that the desired month and year may be viewed. The device is simple and not likely to easily get out of order.

15th St New York N Y The primary object is to provide a shoe string holder which is simple in construction and operation. Another object is to provide a shoe string holder which is readily attached to the upper edge of the shoe to receive the loops of the knot of the shoe lace the holder being adjustable to hold loops of various lengths and to be easily removed by the

use when not desired.

CAMFRA - V CAMERONE 1152 49th St
Brooklyn N Y Among the objects of the
invention is to provide a film winding
mechanism which may be operated to position
an unexposed section of the film strip
behind the shutter opening after each operation
of the shutter. A further object is to
provide an automatic winding of the film by
which the paper strip on the film will be
wound upon the spool before the first exposure
and after the last in order that
the spool may be removed from the camera
without danger to the exposed sections.

COMBINATION FURNITURE—A I
NEEL 543 50th St. Brooklyn N Y A
object of this invention is to provide a com
bined table and ironing board the ironin
board being of the folding type. A furthe
object is to so construct the ironing boar
that it will be foldable within the tabl
when not in use and supported by the tabl
when in operative position

TIME INDICATOR—O. W. JAMISON
Bank of Westby Westby Wis The inven-
tion relates to direct reading indicat-
computing devices. An object is to provide
device for use in banks and like institu-
in the calculating of the number of days
occurring between two given dates.
Further object is to provide a device having
means for faciliating results without a
manipulation of the device being required.

SILICATE COMPOSITION—L. BREKID
46 W 11th St New York N
The object of this invention is to provide
silicate composition adapted to serve as
a bonding or other metallic paint liquid
while as a leather dressing or as a sub-
strate for varnish and shellac which is in-
destructible, inodorous, dries quickly with
irresilient gloss and mixes well with bro-
wder, ink, or dyes. The composition
sodium silicate having a dona-
E. A. J.

BINDING, CASE FOR HOLDING SHEET MUSIC AND THE LIKE—J. H. WEST 9 Barb'y Hill Rd. Prekham E. Embervauld London S E 15 England The invention relates to hiving cases for holding sheet music and other double leaf paper. The primary object of the invention is to provide a binding case so constructed as to allow any sheeted paper contained therein to lie flat without tendency to curl or warp when the binding case is held open. In carrying out the invention, a sheet of paper is folded in half lengthwise and the

(GRAND STAND) CONSTRUCTION
J. J. LAMBERT, 5 Fairchild St., Iowa City, Iowa. The general object of the invention is to provide a grand stand structure formed of steel plating in step form providing on the upper surface thereof a series of seats. The structure as a whole reflecting practical considerations with respect to strength and simplicity of construction, arrangement of bracing and the character of the seats.

RIX I'ITAC LI'—J. RAGGIO and F. H. JOHNSON 617 53rd St. Brooklyn N.Y. C

COI LAEPIBFL DRAWING BOARD
L OKEWARTS Frankfort Ky The
for its object to provide a c
drawing board which compr
minimum number of parts which can
quickly and readily assembled or dis
assembled and when disassembled can
packed in a small space for transportat
and the convenience of a traveling man. The
service is not intended as a piece of off
furniture.

CHECK PERFORATOR. — R. HAYES, Box 117, Nevada Mo. Among the objects of the invention is to provide a simple device that may be employed to quickly perforate checks following the lines of the letters and numerals in the amount for which the check is drawn. The device is portable and serves to prevent tampering with the check after once drawn.

BANK CHECK AND CHECK BOOK
 R. JAYNE Box 117 Nevada Mo. An object of this invention is to provide a safe check to prevent the check being raised materially beyond the amount for which it is drawn. A further object is to provide a check book having a cutter or severing attachment for detaching a corner or corner

the check designating the monetary value and the amount for which the check is drawn. (See Fig. 8.)

DISPENSABLE—G A DONALDSON, Grand Ill. The invention relates to dispensers of thin material such as cardboard, metal or the like an object being to provide means for preventing accidental movement of the back stay when the latter is in operative position. A further object is to provide a back stay which will hold flat and an attachment which will hold the back stay substantially flat.

PLANT RECEPTACLE - F C WILSON
 1000 Carroll Ave New Orleans La 70119
 The object of the invention is to provide a baffled
 plant outlet in the bottom of a plant receptacle
 which will permit an excess of water to escape
 but which will hold back the soil in the receptacle.
 The device is intended to be applied to what are
 commonly known as concrete or cement pots, boxes or
 tubs.

TOY FURNITURE - A DUFFEL
 1000 Carroll Ave New Orleans La 70119
 The object of the invention is to provide a toy
 furniture set which is made of a material which is
 resistant to fire, heat, and cold, and which is
 resistant to the action of acids and alkalis.

This invention is to provide elements or units of construction which when united will form various articles of furniture. A further object is to provide for furniture made up of separate metal parts having an arrangement of comping which enable the parts to be readily assembled and which will be strong and durable to withstand rough usage.

valve has reference more particularly to the construction which is especially applicable in irrigating and the like systems of water distribution. The primary object is to provide a valve which as simple in construction as possible and yet capable of carrying out its intended use with efficiency and convenience both in its installing and manner of operation.

CONCRETE WALL CONSTRUCTION

—A H NELSON 530 N Center St, Tulsa, Okla. The principal object of the in-

STEREOPTICON DEVICE.—W H Cuddy, American, Ga. The invention relates to devices generally for picture projecting means.

stereoscopic pictures for entertainment purposes. The purpose is to provide a simple and inexpensive stereoscopic device designed for attachment to the lamp housing of a motion picture projecting apparatus, by means of which an inverting meter on a transparent style can be projected and displayed.

4ve Mamaroneck, N. Y. The general ob-
ject of the invention is to provide a raising
and lowering means of simple construction
adapted to wind in and pay out the suspens-
ing ropes or cables in the raising and lower-
ing of a scaffold the special object being to
insure safety and positively and auto-
matically preventing the accidental dropping
of the scaffold either at one or both ends

CLOTHESLINE REEL.—J. Minnow
1833 W 26th St Cleveland Ohio. Among
the objects of the invention is to provide
a reel which facilitates the putting up of
taking down of a clothes line in that it
allows any desired length of line to be used
without danger of dragging the line on the
ground. A further object is to provide
means which prevent twisting and injurious
bending of the line compelling it to wind
smoothly and thereby lengthen the life of
the line.

HAIR CURLER--E CALKINS 518 N
 Attest 100 Main St Watertown, WI
 An object of the invention is to provide a covered wire passing through the curler and having loops at the ends which permit the ends to be bent over the hair after the latter is wound on the main portion of the curler and to prevent possibility of entangling the wire in the hair.

TABLE-SLIDE CONSTRUCTION--E
 Attest 100 Main St Watertown, WI
 An object of the invention is to provide a

able slide construction in which the sliding members have L grooves so constructed as to provide the maximum amount of supporting surface to the plates connecting the members together. A further object is to provide a device in which the end sliding members are adapted to be raised slightly so as to provide the raising of the ends of the table.

BAG—A. J. FARNSWORTH and E. M. S. CLARK 516 North St. San Francisco, Calif.

ACQUSTIC DEVICE--H D Brown
c/o A Feinberg 280 Madison Ave, New York 17, N.Y.

...a device adapted to be worn upon the person of those whose hearing is defective for the purpose of transmitting and intensifying sound waves and vibrations to the inner ear in order to alleviate discomforts caused by defective hearing, the sound waves being transmitted to the ear at a point opposite the petromastoid portion of the temporal bone.

ASSOCIATION VANTY BOX—A
 Mrs. Myer Hall, 108 Belmont St., Boston

lyn, N. Y. An object of the invention is to provide a neat and attractive assemblage of containers in which articles and materials may be supported which a lady may need and which will facilitate the use of the contents of the boxes. A further object is to provide a device in which a plurality of separate containers are rigidly secured to a neat and attractive assemblage.

CENTRAL HEAD—D. Bannerman, Box 604, Meritt, Texas. The invention relates to well-drilling apparatus, wherein valves are provided which prevent the escape of oil from the control head while the usual sealing device is in the process of being moved. A purpose is the provision of a control head in which the valves are arranged for movement in any of the four positions in which the closed position their confronting edges meet and thus prevent the escape of oil for preventing the passage of oil between the valves and drive shaft.

DEVICE FOR STRAIGHTENING PHOTOGRAPHIC PRINTS—C. H. Rian, Capital City, B. I. The invention relates to a mechanical device for straightening photographic prints which have become curved during the process of being developed. The object is to provide a device which includes an endless belt, trained over two rollers and a simple means, whereby to cause the same to run true, and the same adapted to connect with the belt for delivering the straightened print therefrom in an orderly manner.

APPARATUS FOR WRAPPING OR PLACING UP PACKAGES BAGS, AND TIE LACES—C. C. Tracy, Paris, LaSalle, Kansas and Leola, Kansas. The invention has for its object to provide a device for taking packages from the ground or from a floor and placing them either on a platform or above the ground. The device is arranged in such manner that the packages or apparatus may be raised or lowered on wheels, and pushed to required place and the load deposited.

BUILT UP HEAD FOR CYLINDERS FOR BURNING FURNACES—C. H. Rian, Capital City, B. I. The invention relates to CYLINDERS OF LIKE NATURE.—W. J. Harnett and J. H. Harnett, Madison, Wis. The object of the invention is to provide a cylinder frame cylinder which is constructed in such manner as to permit of the disassembly of the cylinder into sections for the replacement of the shaft upon which the cylinder is mounted with the necessity of removing the cylinder from the furnace obviated.

AUTOMATIC BEARING ADJUSTER.—J. J. Hunt, c/o Mill Rock Co., Harpersport, Iowa. An object of the invention is to provide a device that is adapted to be attached to a bearing and is automatically operated to adjust the parts of the bearing relatively in order to compensate for wear on the bearing and on a member journaled therein. A further object is to provide a device in which the adjustment of the parts is effected by spring actuated means. The device is adapted to be applied to an ordinary bearing without extensive changes.

POLYART DIPPING MACHINE—C. E. Harnett, c/o Automatic Polyart Dipping Co., Wichita, Kan. An object of the invention is to provide means for removing resin and seal from the surface of a material and for automatically dipping the polyart, and thereby relieving the caretaker of the tedious method. The device is constructed in such manner that the material to be dipped is drawn up to be put in communication with the outlet of the polyart, and is provided with a hinged bottom which will automatically drop the polyart by its own weight into the polyart bath.

WARPING SEAT—A. J. Paine, c/o A. M. Reymann, 200 W. 12th St., Duluth, Minn., R. I. This invention relates to seats adapted to be attached to a warping machine, to provide a seat for operators. The object is to provide a device adapted to be attached to a desirable position with means, which enable means whereby the weight of an operator to operate the control member of the machine.

Medical Devices.
BED BATHING APPARATUS—L. E. Harnett, 207 Hill St., Seattle, Wash. The object of the invention is to provide a device or apparatus which may be easily and quickly attached to a bed and arranged for bathing a patient in the bed without the necessity of leaving the patient. A further object is to so construct the apparatus that the patient is folded into a compact bundle and transported from place to place by a nurse or other person.

SUPPORT FOR INVAILDS—G. K. Harnett, 50 So. Duane St., Montreal, Canada. Among the objects of the invention is to provide a device for supporting a patient associated with hospital beds or any type of bed to provide a convenient support for

maintaining the invalid or patient in an elevated position. By the use of this device the patient is maintained in proper position although not so restricted as to prevent him from partaking of such movements as are proper and necessary.

SURGICAL INSTRUMENT—D. L. O'Connor, c/o George Thompson & Co., 107 Park View, New York, N. Y. An object of the invention is the construction of a surgical instrument by means of which the hands may be removed from the mouth of a patient without any danger of becoming lodged in the mouth. The instrument is constructed in such a manner that it is permitted by means of a simple device to be inserted into the mouth, and with less danger of a hemorrhage.

TRUSS—W. Schultz, Menard, Texas. The object of the invention is to provide a truss in which provision is made for the alleviation of what are known as muscle spasms, the primary object being the provision of a simple, inexpensive form of truss which may be freely and easily maintained in proper place with minimum discomfort.

Medical Devices.
LEAF TURNER—D. Harnett, 504 W. 4th Street, Ave., Brooklyn, N. Y. One of the principal objects of the invention is to provide a mechanical means for the automatic turning leaves or sheets whereby manual labor is thereby saved. The object of the invention is to provide a means for the automatic turning of the leaves of a book. A further object is to provide turning mechanism in the form of a single wheel which may be applied to a plate or the like, and a pedal or other means actuating means for turning the sheet.

Prime Movers and Their Accessories.
VALVE TURNER—A. H. Werners, 540 Columbia St., Chicago, Ill. The object of the invention is to provide a carburetor valve turner for use in connection with a mixture during idling, and high speed mixture will additionally provide an efficient accelerating mixture during the motor to readily take hold during the mixture, and virtually free the carburetor from the necessity of being upon its being manually subjected to a load, at a low engine speed.

GASOLINE FUEL VALVE TURNER—D. Bonnett, 100 W. Holmstead St., Wabash, Ind. The object of the invention is to provide a device for mixing the gas fuel elements of internal combustion engine. An object is to provide a device of simple construction which may be placed in the pipe leading from the carburetor to the manifold of the engine, and secured by a mechanism having no movable parts, thus avoiding likelihood of jam or derangement, and avoiding the improper introduction of raw gas into the engine.

VALVE TIGHTENING SPRINGER—C. W. Moore and C. K. Moore, 428 10th Ave., Duluth, Minn. The primary object of the invention is to provide a device which is adapted to be applied to the valve of an engine, and by means of which the valve condition may be adjusted by means of a screw or nut, and further to so construct the device that the valve may be adjusted without the necessity of changing the engine to accommodate the same.

ROTARY ENGINE—R. R. Koonen, c/o W. H. Koonen, 100 W. 10th St., Washington, Pa. An object of the invention is to provide a rotary engine on which means for automatically and gradually cutting off the flow of fluid into the working chamber, and by means of which the mutually associated and cooperating parts of the engine may be adjusted to work during a portion of the rotation.

Pertaining to Vehicles.
DUMPING BODY FOR VEHICLES—C. H. Rian, Capital City, B. I. The object of this invention is to provide a dump body for automobiles and all other vehicles which will enable the carrying and securing dumping of material in the bed of the vehicle, and by means of which the material may be conveyed carrying and simultaneously dumping of the material. The dumping body consists of two hinged parallel plates, the lower plate being provided with a device for elevating the body from the truck to dumping position.

VEHICLE WHEELS—A. Harnett, Box 754, Central Station, Leola, Kan. The invention has been granted two patents of a device for wheels for automobiles and trucks in which the inflated tire structure thereby is held in position, and the tire is provided to maintain wear thereon, the object is to provide a wheel structure which

functions properly in the emergency of the deflated tire, and by means of a transverse tire, but in which a solid rubber tread is provided, and the tire is held in position by means of a device which is adapted to prevent or hinder the escape of air from the tire.

VEHICLE—J. Paine, 1408 N. Kimball Ave., Chicago, Ill. The invention relates to a vehicle which is adapted to be used in the form of a truck, and the like. An object is to provide a vehicle which is adapted to be used in the form of a truck, and the like. An object is to provide a vehicle which is adapted to be used in the form of a truck, and the like. An object is to provide a vehicle which is adapted to be used in the form of a truck, and the like.

TRUCK UNLOADER—C. H. Rian, 401 Collins St., Joliet, Ill. An object of the invention is to provide an unloading device for trucks, and the like. An object is to provide a device for unloading trucks, and the like. An object is to provide a device for unloading trucks, and the like. An object is to provide a device for unloading trucks, and the like.

SHARING—C. H. Rian, 401 Collins St., Joliet, Ill. The invention relates to a device for sharing, and the like. An object is to provide a device for sharing, and the like. An object is to provide a device for sharing, and the like. An object is to provide a device for sharing, and the like.

AUTOMOBILE TOP—S. H. Harnett, 100 W. 10th St., Washington, Pa. The invention relates to a device for providing a top for an automobile, and the like. An object is to provide a device for providing a top for an automobile, and the like. An object is to provide a device for providing a top for an automobile, and the like. An object is to provide a device for providing a top for an automobile, and the like.

PERMUTATION LOCK FOR IGNITION SYSTEMS—C. H. Rian, 401 Collins St., Joliet, Ill. The invention relates to a device for providing a lock for an ignition system, and the like. An object is to provide a device for providing a lock for an ignition system, and the like. An object is to provide a device for providing a lock for an ignition system, and the like. An object is to provide a device for providing a lock for an ignition system, and the like.

TIRE CAMBER—J. R. Koon, 220 Hill St., Duluth, Minn. The invention relates to a device for adjusting the camber of a tire, and the like. An object is to provide a device for adjusting the camber of a tire, and the like. An object is to provide a device for adjusting the camber of a tire, and the like. An object is to provide a device for adjusting the camber of a tire, and the like.

ADJUSTABLE JAW—W. H. Brown, 500 So. Duane St., Montreal, Canada. The invention has been granted two patents of a device for adjusting the jaw of a vehicle, and the like. An object is to provide a device for adjusting the jaw of a vehicle, and the like. An object is to provide a device for adjusting the jaw of a vehicle, and the like. An object is to provide a device for adjusting the jaw of a vehicle, and the like.

WHEEL LOCK—J. R. Koon, 220 Hill St., Duluth, Minn. The invention relates to a device for locking a wheel, and the like. An object is to provide a device for locking a wheel, and the like. An object is to provide a device for locking a wheel, and the like. An object is to provide a device for locking a wheel, and the like.

REPAIRING DEVICE FOR EXHAUST SYSTEMS—C. H. Rian, 401 Collins St., Joliet, Ill. The invention relates to a device for repairing an exhaust system, and the like. An object is to provide a device for repairing an exhaust system, and the like. An object is to provide a device for repairing an exhaust system, and the like. An object is to provide a device for repairing an exhaust system, and the like.

provided in such mechanical device, and the device is adapted to be used in the form of a truck, and the like. An object is to provide a device for providing a top for an automobile, and the like. An object is to provide a device for providing a top for an automobile, and the like.

EXTENSION LAMP—W. F. Paine, 107 Hill Ave., Duluth, Minn. The object of the invention is to provide a device for extending a lamp, and the like. An object is to provide a device for extending a lamp, and the like. An object is to provide a device for extending a lamp, and the like. An object is to provide a device for extending a lamp, and the like.

AUTOMOBILE TIRE RACK—C. W. Harnett, 100 W. 10th St., Washington, Pa. The invention relates to a device for providing a rack for an automobile tire, and the like. An object is to provide a device for providing a rack for an automobile tire, and the like. An object is to provide a device for providing a rack for an automobile tire, and the like. An object is to provide a device for providing a rack for an automobile tire, and the like.

STABILIZING AND ALIGNING DEVICE—C. H. Rian, 401 Collins St., Joliet, Ill. The invention relates to a device for stabilizing and aligning a vehicle, and the like. An object is to provide a device for stabilizing and aligning a vehicle, and the like. An object is to provide a device for stabilizing and aligning a vehicle, and the like. An object is to provide a device for stabilizing and aligning a vehicle, and the like.

FRONT DRIVE FOR MOTOR VEHICLES—M. G. Harnett, 100 W. 10th St., Washington, Pa. The invention relates to a device for providing a front drive for a motor vehicle, and the like. An object is to provide a device for providing a front drive for a motor vehicle, and the like. An object is to provide a device for providing a front drive for a motor vehicle, and the like. An object is to provide a device for providing a front drive for a motor vehicle, and the like.

VALVE—W. H. Brown, 500 So. Duane St., Montreal, Canada. The invention relates to a device for providing a valve, and the like. An object is to provide a device for providing a valve, and the like. An object is to provide a device for providing a valve, and the like. An object is to provide a device for providing a valve, and the like.

NON PERMUTATION TIRE—C. A. Paine, 500 So. Duane St., Montreal, Canada. The invention relates to a device for providing a tire, and the like. An object is to provide a device for providing a tire, and the like. An object is to provide a device for providing a tire, and the like. An object is to provide a device for providing a tire, and the like.

DESIGN FOR LAMP—C. H. Rian, 401 Collins St., Joliet, Ill. The invention relates to a device for providing a lamp, and the like. An object is to provide a device for providing a lamp, and the like. An object is to provide a device for providing a lamp, and the like. An object is to provide a device for providing a lamp, and the like.

DESIGN FOR A MOTOR SUPPORT—J. R. Koon, 220 Hill St., Duluth, Minn. The invention relates to a device for providing a motor support, and the like. An object is to provide a device for providing a motor support, and the like. An object is to provide a device for providing a motor support, and the like. An object is to provide a device for providing a motor support, and the like.

DESIGN FOR A TIRE—C. H. Rian, 401 Collins St., Joliet, Ill. The invention relates to a device for providing a tire, and the like. An object is to provide a device for providing a tire, and the like. An object is to provide a device for providing a tire, and the like. An object is to provide a device for providing a tire, and the like.

DESIGN FOR A WHEEL—C. H. Rian, 401 Collins St., Joliet, Ill. The invention relates to a device for providing a wheel, and the like. An object is to provide a device for providing a wheel, and the like. An object is to provide a device for providing a wheel, and the like. An object is to provide a device for providing a wheel, and the like.

Study of Material and Methods Needed in Non-Metallic Gear Production

Quiet gear-driven front end obtained Tests with a typical product indicate blanks are more expensive than metallic type. Fewer tear-downs and easier inspection offset extra cost. Analysis of manufacturing processes improves results

By J. Edward Schipper

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AQUIET front end drive at little or no increase in cost can be obtained by using non-metallic materials, provided proper precautions are taken in the production process. Blanks and non-metallic gears are more expensive than those for steel, but in the different parts of the manufacturing process a reduction in the number of operations for safety inspection, and, consequently, of the tear-downs and rebuilding operations. Therefore, the material is used to best advantage only if the manufacturer first obtains intimate knowledge of the properties of the best methods of handling it.

Where gear drive is used for the front end, the problem of silent operation will probably first be attacked by the manufacturer from the standpoint of improving the metallic gear. In analyzing these problems, it will inevitably find that the difficulties are, first, the high cost of obtaining accurate geometry in gear manufacture, and, second, the resistance of the material itself.

The expense of producing metallic gears to accurate geometry logically leads to a study of non-metallic materials, with which optimum can be secured without going to the expense in low resistance blanks. Recently there has been considerable discussion of the possibilities of grinding steel gear teeth to obtain accuracy. Owing to the limitations of gear grinding machines up to this time, this, of course, would involve a return to the type of gear, a rather drastic step. Developments along this line would be of great interest.

The Formica Insulation Co., manufacturer of non-metallic gear blanks, has made an interesting study of just what can be accomplished with non-metallic material. This concern has more than twenty years' experience in the use of this material. It maintains that the fundamental requirements of gear material is that it not only must be able to withstand the stress set up by normal loads, but also to take care of overload and shock stresses.

Metal gears fulfill this requirement, but it is difficult to keep them silent except behind slight inaccuracies are likely to occur in their manufacture. The metal is not elastic enough to compensate for these inaccuracies when the gear is in operation, and the "ring" of metal striking metal at high speeds forms an undesirable noise.

It is the character between gears caused by whiplash of shafts at high speed and by a slight change of position of the teeth on the pitch circle that causes this action. Non-metallic material should have the required strength, should be silent and hold constant, and, in addition, be more elastic and non-resistant. For the same degree of impact, the non-metallic gear would be quieter, because the vibrations set up by the tooth hammer due to the inaccuracy of the gear form would be less.

It must be considered that non-metallic material is produced much less expensively than steel, but falls down in service. There has been a great deal of development done that time, and the result that it is now possible to secure products having the required utility and endurance. As the material is non-metallic, the Formica Insulation Co., the concern nearest about the knowledge of how to manufacture the gears. One manufacturer who has used non-metallic material for years gives the following rules for the production of the gears:

"This of processes you would find in cutting a good deal of metallic turning gear. Speed plenty of time and the substance of your non-metallic gear blanks. Learn by experiment to behave on the gear cutting machine as well as what installed in the driving gear train."

This manufacturer states that attempts to make the non-metallic gear cutting problem will fail the worst plans of one, without a knowledge of the physical characteristics of the blanks, their weight, and the speed of gear and not select one of the very inefficient and costly one of changing material. The Formica Insulation Co. states that the material is not elastic enough to compensate for these inaccuracies when the gear is in operation, and the "ring" of metal striking metal at high speeds forms an undesirable noise.

As the opinion of this manufacturer seems to agree with that of most others who have expressed this opinion, it is not surprising that it is a question of the price paid by him will be of interest. It is necessary to have good machines, in particular, turning, turning, turning, etc., on which to cut or bore the gear. The material is then subjected to either rough or the "finishing" of blanks on a lathe. It is necessary to keep the lathe sharp.

In cutting non-metallic gears, the blanks must be worked up as so to avoid breaking out good. As the Formica Insulation Co. states, the use of the non-metallic materials can be handled like these. Some materials are cut dry. Formica being one of these.

Another manufacturer who has found that non-metallic gears are

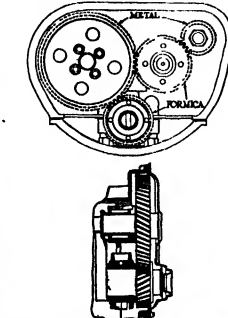


Fig. 5—Four-view drive on rim on revolving Formica gear, on rim and side gears, and metal gears for the camshaft and generator drive gears.

entirely satisfactory as far as wearing qualities and silence are concerned, stress that lapping compound of any kind should not be used in running in the case-gear with a metal gear. The above is the lapping compound inside itself in the gear and very shortly runs away the teeth of the non-metallic gear. The manufacturer further states that he suspects that this practice has contributed to say lack of success with non-metallic gears.

Advantages for Formica Gears

It is, however, a fact that Formica gears, as used in the front end drive on the particular car in both four and six-cylinder types, have proved satisfactory in the manufacture. This concern has the gears with approximately the same blank as used with metal gears. The turning time on this car has only two gears, the generator and fan assembly, driven from a pulley mounted on the crankshaft extension. The water pump is mounted on the end of the front end of the crankshaft. Numerous secondary magnets are mounted on the front end of the crankshaft.

Most of the manufacturing using gears of Formica or a similar compound have found that more liberal inspection for backlash are possible. The shaft centers, however, must be held quite close. One concern says the Formica gears to have about 0.002 in. backlash. If the tooth form and bulk are held within narrow limits, the results have proved very satisfactory. If not accurate, the gears wear out rapidly, and nearly every case of undue destruction has been chargeable to improper tooth form or error in the size of the teeth.

In manufacturing timing gears from non-metallic substances, it is necessary to check the material very closely while setting up the tools, as the material has a slight tendency to spring away from the cutter in machining. The Material Inspector Co. has found that the Formica can be held as on metallic gears. When this is done a quiet front end is possible with negligible interference in assembly.

Could the points which it is discussed probably prove that any other in comparison with the use of non-metallic materials for front end drive, in which the camshaft gear or the smaller crankshaft and generator gears should be made of non-metallic. For a long time it was believed that the camshaft gear should be non-metallic, but it is better to make the two smaller gears non-metallic. The reason is advanced for that the teeth of the crankshaft and generator gears were only as the point of meshing with the camshaft gear, whereas the camshaft gear has two gear teeth meshing with the camshaft gear and the generator gear meshing with the camshaft gear. Furthermore, there is an upward reaction action upon the camshaft gear. At no point is it being driven by the crankshaft gear, as when the latter drives the generator gear. Hence, the fact that the camshaft gear has twice the influence of such is more than offset by the double and upward, were explained above.

Differently in Manufacture Stress

In some cases the comparison camshaft gear is as a disadvantage for



Fig. 1—Two gear trains on the manual machine using Formica gears on the camshaft against a metal camshaft gear.

several reasons. It is quite apparent, for instance, that the strength factors with this type of material decrease very rapidly with increased diameter. Consequently, the smaller gears are far stronger than the larger camshaft gears would be. Furthermore, the cost of the gear blank runs rapidly with increased diameter and, taking account of these various factors, it will be seen that a more durable and lower priced gear can be made if the two smaller gears are made of non-metallic material, rather than the larger camshaft gear.

The development of Formica material has progressed over a number of years, and the method of manufacture is of interest. The big problem is to secure not only the necessary physical properties, but also a high degree of uniformity. Formica is manufactured from a specially woven cotton duck and Redwood resin, the latter being the synthetic product of the Baldwin Corp. A feature of the duck employed is that it possesses the same strength in the warp and in the weave, with the result that the finished material has the same tensile strength both with and across the grain.

The cotton duck, in the form of a continuous web, is subjected to an impregnation process comprising two steps and which is designed to insure the complete impregnation of every fiber of cotton with the resin. After impregnating, the duck is passed through a steam-heated oven, the speed of passage, circulation of air and temperature being automatically controlled. The passage through this steam-heated oven starts the reaction in the phenolic resin, and drives off all volatile materials, including whatever moisture there may be in the duck itself.

After this treatment, the duck is cut into sheets of the proper size, the individual laminations are built up to the desired thickness and subjected to the final curing process in steam heated hydraulic presses, where a pressure of 5000 to 10,000 lbs. per sq. in. is applied. The material is cured at a temperature of about 175 deg. C. The time of curing varies with the thickness of the sheets being manufactured.

The final curing completes the reaction in the phenolic resin and results in the production of a material which is as strong as any of the ordinary materials. The material is removed from the presses and the sheets are then cut into the desired sizes, either in the hand sawing or circular cutter. The material is then subjected to critical inspection with regard to hardness, lamination, tensile strength, compression strength, etc.

The final product has a tensile strength of about 10,000 lbs. per sq. in., a modulus of elasticity of about 1,000,000 lbs. per sq. in. in a tensile direction, a coefficient of expansion of 1/3%, and a coefficient of linear expansion of 0.00002 per deg. Fahr.

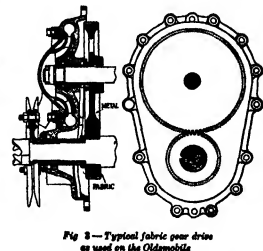


Fig. 3—Typical fabric gear drive as used on the Oldsmobile

Fig. 2—A diagram showing a gear train with a camshaft gear and a generator gear, illustrating the use of Formica gears in a mechanical assembly.

Formica is made and sold by The Formica Insulation Co., Winton Place, Cincinnati, O.



Here they are Sir! the world's most distinguished cigarettes—in a special new size—20 for 30¢



*Try them tonight
for your Luxury Hour*

—that easy chair hour
after the day's toil,
when every man feels
entitled to taste life's
best. . . Soon you will
smoke them *exclusively*

PALL MALL Specials
New size—plain ends only
20 for 30¢

Only change in our system
of Pall Mall Regular
(same day)



For the connoisseur's taste—and the thrifty man's purse—here's the best cigarette news in many a day.

Famous Pall Mall—the most distinguished of all cigarettes—is now available in a special new size—20 for 30¢.

At "a shilling in London— and a quarter here," Pall Malls have always been the world's best cigarette buy. But the makers of Pall Mall have evolved new economies in manufacture which leave the quality intact, while

materially cutting the cost to you. Hence, the new "PALL MALL SPECIAL"—twenty genuine Pall Malls for 30¢—a triumph in volume production.

A *trimmer* cigarette than the Pall Mall Regular—a little smaller in girth, but with plain ends *only*—and with the same exquisite blend of the choicest Turkish tobaccos that has always made Pall Mall incomparable.

Try Pall Mall *Specials* tonight for your Luxury Hour.

20 for 30¢

[WEST OF THE ROCKIES 20 for 35¢]



Men died like flies

The Great Pyramid was built, according to Herodotus, by the bitter toil of 100,000 men for twenty years. Men died like flies.



Wherever hard great big tasks can be lifted from human shoulders by electricity human life is enriched. General Electric Company designs and manufactures machinery by which electricity is generated and put to work.

The world does progress. A modern skyscraper goes up in a fraction of a year—workmen furnishing the skill and General Electric motors the muscle.

GENERAL ELECTRIC



GEARS

For all kinds of machinery, from the smallest to the largest, we have the right gear. We can design and manufacture gears for all kinds of machinery, from the smallest to the largest. We can also repair and rebuild gears for all kinds of machinery, from the smallest to the largest.

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THE VALVE MFG. CO.
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This valve automatically shuts off the flow of steam from header to boiler in case a tube should burst or other internal rupture occur, thereby automatically reducing the pressure in that boiler.

It also equalizes pressure, as between different boilers in a battery preventing one boiler from working at a lower pressure than another.

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Science Notes

A Large Telescope for Argentina.—A 60 inch reflector has recently been completed at a Chacabuco optical works for the Argentine National Observatory. The mechanical equipment is unusually accurate and the optical test is a credit to the optical skill of great firm of J. L. L. of Madrid tools. Distinguished Spanish Astronomers.—The death of 1822 was the lowest of any year excepting one in the history of the United States and Canada, according to the statistics of the Metropolitan Life Insurance Company. The rate was 8.5 percent in each 1000 in 1822 while in 1921 the rate was 8.7 percent.

A "Nutrition" and Intelligence Quotient Slide Rule.—Dr. Thomas D. Wood has designed a new slide rule to simplify "nutrition" calculations in which variations from average weights of children are expressed in terms of percentages of such average. The slide rule has great service for a child initiated but when once mastered is a great time saver.

An Italian Fresh-Water Laboratory.—Lake Trasimene on the road to Rome from Perugia, is of great historical importance, as it was here that Hannibal had gained a narrow battle in 217 B. C. The lake is 15 miles in circumference and the altitude is 160 feet. The new laboratory will be attended by students from several foreign countries.

Another Moon Thief.—Sometime ago we called attention to the moon thief who stole platinum from the terminals of the spinning rods of Henry Jones in Paris and now we have more of this kind of thief. The moon's most important earthquake observatory at Ewingburg was put out of commission when all the bronze parts of the seismograph were stolen. It situated on the Baltic-Mediterranean Plateau the observatory on a red granite position for earthquake investigations.

Worm's Science Museum.—During the recent 19th celebration in Vienna the first of St. Paul's and the beautiful London church designed by Sir Christopher Wren had its first public exhibition. It was the first public exhibition of the first of St. Paul's and the beautiful London church designed by Sir Christopher Wren. It was the first public exhibition of the first of St. Paul's and the beautiful London church designed by Sir Christopher Wren.

A Valve with Five Octaves.—At a meeting of the A. S. T. Society of Engineers in London in 1921, the first of St. Paul's and the beautiful London church designed by Sir Christopher Wren. It was the first public exhibition of the first of St. Paul's and the beautiful London church designed by Sir Christopher Wren.

Widowhood Museum.—Dr. F. A. Lucas, writer of the American Museum of Natural History, thinks that the museum of the widowhood of the British Museum of Natural History, which was founded in 1821, is a credit to the optical skill of great firm of J. L. L. of Madrid tools. Distinguished Spanish Astronomers.—The death of 1822 was the lowest of any year excepting one in the history of the United States and Canada, according to the statistics of the Metropolitan Life Insurance Company.

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AT LAST

A dependable machine valve



AIR - STEAM - GAS

Control valves for all kinds of machinery, from the smallest to the largest, we have the right valve. We can design and manufacture valves for all kinds of machinery, from the smallest to the largest. We can also repair and rebuild valves for all kinds of machinery, from the smallest to the largest.

Most Compact 4 H.P. Outfit

The most compact 4 H.P. outfit for all kinds of machinery, from the smallest to the largest, we have the right outfit. We can design and manufacture outfits for all kinds of machinery, from the smallest to the largest. We can also repair and rebuild outfits for all kinds of machinery, from the smallest to the largest.

CUSHMAN

LIGHT WEIGHT ENGINE
The most compact 4 H.P. outfit for all kinds of machinery, from the smallest to the largest, we have the right outfit. We can design and manufacture outfits for all kinds of machinery, from the smallest to the largest. We can also repair and rebuild outfits for all kinds of machinery, from the smallest to the largest.

Anyone Can Soon Learn to Operate the MONARCH Jr. Lathes

The MONARCH Jr. Lathes Engine Lathes are simple and trouble proof. They are the most compact 4 H.P. outfit for all kinds of machinery, from the smallest to the largest, we have the right outfit. We can design and manufacture outfits for all kinds of machinery, from the smallest to the largest. We can also repair and rebuild outfits for all kinds of machinery, from the smallest to the largest.

THE MONARCH MACHINE TOOL CO.

428 East Street, Bridgeport, Conn.

PARK AVENUE HOTEL

428 Ave. from 2nd to 3rd St. New York

Hotel entrance on 2nd

One of the best hotels in New York, with the most complete service and the most comfortable rooms.

Rooms with bath, from \$10.00 per week.

Rooms with bath, from \$10.00 per week.

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—yet their cost is very low

Kelly Kats are massive single-cushion tires especially designed for heavy- and medium-duty trucks.

They have all the sturdiness of solid rubber tires and can stand punishment even better, yet because of their distinctive construction they are able to do many things which solid tires cannot do.

They get traction without chains on almost any kind or condition of road and cushion a truck practically as well as properly inflated pneumatics.

They offer many advantages over pneumatics because they are more dependable, far longer lived and cost a great deal less.

Whether a truck owner buys tires for the service they give or for the money they save, Kelly Kats will satisfy him.

There are no Caterpillar
tires but Kelly Kats

KELLY-SPRINGFIELD TIRE
COMPANY

250 West 57th Street New York



KELLY KATS

THE TIRES WITH NINE LIVES



And Here are the Reasons

Utica non-shaking tool steel	Seminoles unshakable chisel and
SILCROAE non-corrosive electrical resistant steel	DELUM a non-corrosive and for a thousand uses
MOHAWK EXTRA unmatched high speed steel	PURPLE CUT a better high carbon steel
NEVO-STARK special non-corrosive steel	Iroquois EXTRA the edge holding tool steel
POMPTON a carbon tool steel	DELUM a rustless easy cutting alloy

LUDLUM STEEL

WELLER EQUIPMENT

Wide awake industries are installing equipment to handle their products mechanically—supplanting human labor and reducing operating expenses

More jobs than men will cut production unless machinery is installed to relieve the situation

We Make
Conveyors for handling all kinds of materials
Bucket Elevators
Coal and Ash Handling Equipment, etc.

YOU MAY HAVE A
MATERIAL HANDLING
PROBLEM. SUBMIT IT

WELLER MFG. CO.
1820-1826 N. Kostner Avenue Chicago, Ill.
Sales Offices: New York Boston Baltimore Pittsburgh Cleveland Detroit San Francisco



Electrical Notes

Variable Ball Wiring is a recent British contribution to the electrical field. It consists of two flat copper strips securely held between two paper tapes, which can be easily installed by glue, paste, or cement. The variable ball wire can be fixed on walls under wall paper, on ceilings under white-wash, or on floors under carpet or linoleum. When run on the surface it can be painted or colored to match its surroundings and is then perfectly invisible.

Load-Speaker Voice for Operating Rooms.—An unusual application of loud-speaking equipment is reported in *Medical Electrician*, in connection with the operating room of a French hospital. It appears that above the operating room in question there is a glass roof through which the operations being performed by the surgeon may be followed by medical students. The surgeon, while performing the operation, talks into a microphone in the operating room, and the current is amplified through two vacuum tubes, for delivery to a battery of loud-speakers in the observation room above. In this manner the medical students not only see what is being done in the operating room, but they receive the explanations from the surgeon at the same time.

Transmission at 220,000 Volts is now an accomplished fact. According to *Electrical World*, the switches on the Big Creek lines of the Southern California Edison Company were closed and 220,000 volt transmission became an accomplished fact. The event marks the culmination of years of research, experiment and study of the problems of higher voltage transmission by some of the most prominent electrical engineers in the profession. The Big Creek power house had been operating for some time at 220,000 volts. Before being changed over to 220,000 volt operation additional insulation units were added, making a total of eleven units on suspension and thirteen on wood poles. Each line has a capacity of 225,000 kilowatts at 220,000 volts.

Man Who Made Your Telephone is the title of an attractive advertisement which recently made its appearance in connection with an educational advertising campaign of a leading electrical manufacturer. We learn that we are thankful to many names for our present telephone instruments. The British Indian is the swiftest minor of mice—the insulation inside the telephone. The Japanese prepares the silk used in the covering of the telephone cord. The Russian mines the noble metal, platinum, used for contact points. The Egyptians are responsible for certain cottons used in insulation, which originate in the Nile Valley. The Brazilian drains rubber from a tree, and it is this rubber which forms the case of the receiver. The Irishman rubs wax, from which is made linen paper, used in the telephone condenser. The Pennsylvania oil miner contributes the grades of coal used inside the transmitter—the vocal cords of the telephone, in truth. The Alaskan digg each gold as is used in the telephone. Finally, we have the American workman who, from a slab of rubber, a bundle of vegetable and animal fibers and a curious medley of minerals brought from every corner of the world, produces a marvel of precision and ruggedness—your telephone.

Beetles Which Bore Through Lead Cables, but which, nevertheless, do not or cannot penetrate pure gum rubber, have proved a serious problem and pest in California and many other parts of the United States. One of the most important injuries inflicted by these beetles is the damage done to the lead sheathing of telephone cables in California. The beetles bore circular holes in the sheathing, about one-eighth inch in diameter. Moisture enters the cable through these holes, causing a short-circuiting of the wires and interruption of service to the public. As one hole may put from 50 to 80 or more telephone out of use for from one to ten days, the damage is rather extensive.

From experiments undertaken by the Bureau of Entomology of the United States Department of Agriculture, it has been learned that the beetle is able to penetrate any lead alloy used as a cable sheathing or any paint or repellent placed on it. Probably it is able to penetrate the poison, because it does not eat food as it bores through. Next to the beetle, which seldom, if ever, is killed, when infested with soil, will go to the beetle and suffocate it, and has been used with some success on the rim which must be kept tight. The beetle is also boring in some near the rings. Layers of friction tape inside the lead and sheaths of copper, steel and steel pipe.

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The largest selling quality pencil in the world

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17 Black Degrees
3 Copying

To insure utmost satisfaction, efficiency and economy, always use **VENUS** Pencil, unsurpassed for general use, or for sketching, sketching, or any particular purpose.

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Pencil Made, per dozen: 61.15
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107 Park Ave., New York
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VENUS PENCILS are perfect imitations
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The complete range of electrical engineering services, including design, construction, maintenance, and repair of electrical equipment, is available from the experts of the **Electrical Engineering** department.

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Over 100,000 Pencil 100% Satisfaction
Pencil Made, per dozen: 61.15
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Park Your Hat
Don't leave your hat on the drive when you leave your car. The **Park Your Hat** hat rack is the only hat rack that is safe, secure, and convenient. It is made of heavy metal and is designed to hold your hat securely in place. It is the only hat rack that is safe, secure, and convenient. It is made of heavy metal and is designed to hold your hat securely in place.

from home

The most complete line of home appliances, including refrigerators, stoves, and washers, is available from the experts of the **from home** department.

Absorbine J

The most complete line of home appliances, including refrigerators, stoves, and washers, is available from the experts of the **Absorbine J** department.

To Users of SAWDUST

The most complete line of home appliances, including refrigerators, stoves, and washers, is available from the experts of the **To Users of SAWDUST** department.



Why?

UP in the freezing altitudes the flyers—in sweaters, in furs, in leather coats and helmets!

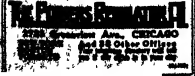
Down on the leveling field the crowd—sweating and panting with the heat!

Yet the body-heat of the aviators, in spite of external temperature changes, and the body-heat of every healthy member of that crowd, is the same. Why?

Because the human body is provided with perfect automatic temperature control—the vaso-motor nervous system. Regardless of weather or climate, man's normal temperature always remains the same.

Powers Automatic Temperature Regulation System is the closest human approach to the perfection of Nature's method. It will render the same reliable, accurate, and unobtrusive service in equalizing the temperature in the buildings you design—offsetting for a lifetime without a single adjustment or repair.

Let our engineers collaborate in your preliminary plans. Over 30 years' experience at your service.



Invention and the "Grifter"

(Continued from page 132)

slightest hint of unusual familiarity. And then, turning to the crowd:

"These four disks belong to the gentleman there. Please remember they are mine! Not to be played foul! Anybody else is yours, my friends! Stop right up and win the fresh untolded poultry!"

The Houdini trick game is conducted in a very simple manner. Barbed in the earth under the legs or buttocks are a number of stiff wires which lead to taps, plungers or buttons in several parts of the grifter's attire. These control the false bottoms of the various receptacles. If a tried stroller tries to grifter negligents to touch or step on any of these controls and the spring bottom does not rise. Naturally, the friend wins. But let the sucker come by with his money and instantly the grifter's trousers rise. The crowd and there is no winning. The ball hits the spring bottom and out it goes.

Whoever has attended a street fair remembers the various prize wheels or "spinners" as they are called by the park and carnal trade. They are all, in some sense, imitations of the roulette wheel. In the good old days they were spun for money prizes. Today they usually "spin" for dolls or candy or blankets or near-Christmas toys.

I regret to say that the vast majority of these wheels are gamed (the grifter term for fixed, when applied to a wheel) in various and clever ways. Some are mechanically or electrically controlled. At the moment when the number winning the valuable prize has just passed the needle, the grifter leans against his table, thus connecting a switch and causing the wheel to divide to a stop before it can circle back to the winning number. Others are mechanically stopped at the wrong place, by use of a brake either upon the rim of the wheel or upon the axle of the handle.

Before I go too far about this line, however, let me record an interesting fact. The games played in summer parks and along beachfronts are gradually verging toward complete honesty. Not one out of ten of all games now is gamed as what the grifter calls "operation racket." By that he means that the operator of the booth gets a high price or "percentage" but does not fix up or flimflam.

For instance, in every park and on every beachfront today are various race horses, balloons inflating, automobile racing and similar mechanisms. I saw a mechanical horse on the beach, however or museum before the place is a circular disk which he rotates. This turned wheel controls the movements of a certain balloon, horse or even. There are usually from ten to twenty such mechanical controls for players. Each player pays ten or fifteen cents. Thus a two-wheel game, at fifteen cents a play, was operated all last summer, in a resort where I was stopping, for prizes of fancy basketballware. Every time the grifter started his mechanism he took in a dollar and a half and gave out an ornate basket whose wholesale price was and is less than fifty cents.

But, remember, it's summer, the crowd is numerous or numerous. The amount of gambling for something is worth all the difference in value. And there is a peculiar public psychology about the whole thing. A woman friend had her heart set on a rather fine looking pair of Japanese kimono robes which in a booth at Atlantic City last year she bought for \$100. The kimono robes were the real thing, of which it was the highest prize (the Saturday evening she came by her after she had been playing for months and keeping her word in the oriental grifter's hands). She had won extra money and finally accumulated enough points to take home the prize.

"Well, I just relief at these tonight," she said exuberantly, "daddy loves 'em!"

By consulting with the friendly Japanese and his more book, I found the robe had actually cost her seventy-three dollars. Its retail value was not more than ten dollars. But though these persistent games go on in favor, the old tricks survive and the public seems to give them unwavering affection. There is the strength testing sleds machine. You screw a plunger and stand a weight up a wire line to ring a gong at the top of a tall beam. The number of pounds of supported pressure are registered on the sides of the upright column. All day long some lanky bloated athlete stands there and sends the weight to the top at every blow of his mallet. But when you step up—the difference! The grifter has simply moved a little control which warps the track-wise

(Continued on page 142)

Snow-storms often cost as much as big fires



THE Fifth Avenue Chamber of Commerce estimates that a certain heavy snow-storm cost the merchants of New York \$400,000,000 loss to business alone. When to this is added the loss to transportation companies, the cost of removal, and the heavy loss in factory and other production because employees come late or not at all, the total becomes impressive even in small cities. The same amount of fire loss caused by inadequate fire fighting methods would cause indignant and effective protests, but snow losses are still considered unavoidable by many. Numerous cities, however, have found that fighting snow is very much like fighting fire—it should begin with the snowfall and not wait until the storm is over. Second, it should have proper equipment. It should not depend on the shovel any more than fire-fighting should depend on the bucket line. In order to devise economical but effective methods and forces before the battle, and to provide the proper equipment before it is needed rather than wait for it after the damage is done, aggressive municipalities, street railways and chambers of commerce begin their planning and educational work in August. A Barber-Greene snow-fighting engineer is always available to present the methods and plans of those who have made progress in the fight against snow. Send for additional data.

BARBER-GREENE COMPANY, Representatives in 32 Cities Western Park Ave., Aurora, Ill.



Portable Belt Conveyors Self Feeding Bucket Loaders

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If you have an invention which you anticipate will be valuable, it should be placed in the hands of a professional man, who will secure for you the best protection possible. The Scientific American Patent Office, 100 Nassau Street, New York, has been established since 1832, and has a long and successful record in securing patents and protecting the rights of inventors.

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We will be pleased to send, without charge, our Handbook on United States and Foreign Patents, Trade-marks and Copyrights.

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Classified Advertisements—Continued

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PAVING MACHINE. The "Pavement" machine, built in 1890, is the best of its kind. It is now for sale at a low price. Write for particulars to J. J. Munn, 180 Nassau Street, New York.

IMPROVED MARK TUBE

WE KNOW YOU have to use the most reliable and efficient means of marking. The "Improved Mark Tube" is the best of its kind. It is now for sale at a low price. Write for particulars to J. J. Munn, 180 Nassau Street, New York.

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BROWN & LABORATORY EXPERT
The "Brown & Laboratory Expert" is the best of its kind. It is now for sale at a low price. Write for particulars to J. J. Munn, 180 Nassau Street, New York.

WORLD-BOUNDED BUSINESS

The "World-Bounded Business" is the best of its kind. It is now for sale at a low price. Write for particulars to J. J. Munn, 180 Nassau Street, New York.

MAIL ORDER METHODS

The "Mail Order Methods" is the best of its kind. It is now for sale at a low price. Write for particulars to J. J. Munn, 180 Nassau Street, New York.

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The "Manufacturing Facilities" is the best of its kind. It is now for sale at a low price. Write for particulars to J. J. Munn, 180 Nassau Street, New York.

RESEARCH LABORATORY

The "Research Laboratory" is the best of its kind. It is now for sale at a low price. Write for particulars to J. J. Munn, 180 Nassau Street, New York.

THROUGH SEASONS

The "Through Seasons" is the best of its kind. It is now for sale at a low price. Write for particulars to J. J. Munn, 180 Nassau Street, New York.

STANDARD MEASURES

The "Standard Measures" is the best of its kind. It is now for sale at a low price. Write for particulars to J. J. Munn, 180 Nassau Street, New York.

police, based upon the habits of the race to swaggers, no doubt, but Americans are especially addicted. So the various games of this sort have a perennial vogue.

Many one, young, of course, that the dapper who poles his head through a curtain and allows the boys, young and old, to try hitting it with a baseball—three shots in a time—has a steel plate and wig of wood on top of his head with a thick felt batting under it.

Other throwing games are full of similar tricks. I cannot hope to explain them all in a single article. But take the familiar cat rack. There are some dozen forms of it, but the underlying idea is always the same. Under, about thirty feet away, is a cat or a row of cats made of canvas and sawn. Knock the kitten down with baseballs, according to the rules of each individual grifter, and you win the sub rosa prize. Usually these cats are so weighted at the bottom that even a speedily thrown ball will do no more than move them, unless it hits them at the pivotal point. The grifter tells you where to hit them. In all honesty. But to use the vernacular—try and do it!

Early this year, at one of the parties, I saw a row of these cats on their bench and long familiarity told me they were not loaded. Before the grifter knew what was happening I picked up three balls and, foolishly proud of my good aim, knocked down three of his cats. He immediately and smilingly opened his box of other perfumery and I declined. Quite according to form, since we were alone, he offered me a bet. I declined it to be sure, and he set his cats back on the bench. I asked him what the game was.

"Try and knock them off again," he said.

I did. Five or six times I hit a cat squarely and with force. The stuffed canvas cat jumped, whirled and danced but they did not fall off the bench.

The grifter led me to the back of his "house" and showed me a second cat which stretched across the back of his cat bench. When he wanted anyone to win he let the wire loose and tumbled him if he desired no winners, he stopped on a plug or tossed under a bar and let the wire fall. The only way to knock a cat off the bench was to break the wire by laughing and talking. After I had gone to the front again and satisfied myself that the lights were so arranged that no man could find the wire, even though he knew it was there.

"Knock down the cats, boys! Pay as falling off a log. Just a little speed and control! Merely a game of skill, boys! The grifter's cry tempted me down the pavement. To surmise down the favorite spirit of man devote itself—the same spirit that lifted an ape to Furusawa. What can one expect in the pool of summer time?

The Reconstructed "Leviathan"

(Continued from page 109)

A ship like the "Leviathan" is a floating hotel, and there this is a technical article we can do no more than say that the state rooms, assembly rooms, social hall, restaurant, dining room, etc., have all been thoughtfully redecorated along distinctly American lines. While the best features of the German carving and architectural decorations have been preserved, the color scheme has been changed to the soft tones which characterize the prevailing internal decoration of American homes. The cost of structural and engineering reconstruction, the refurbishing and decoration of the living accommodations, the superintendence, etc., brought the total expense, by the time the ship reached New York, up to \$6,000,000.

Can the "Leviathan" win the "blue ribbon of the Atlantic" which at present is held by the "Mauretania," with a record of 50.01 knots average for the eastward passage? This summer will tell the story. With her new improvements, she should have no difficulty in surpassing the "Mauretania" record of 24.6 knots average for the crossing, and every effort will be made to equate the long-standing record of the famous old Clansman, which has stood for 15 years.

Concrete in the Making

(Continued from page 105)

not less than 75 per cent of the finished cement must shake through this sieve. Yet the sieve itself will hold water.

Those who claim that it is wiser now than fifty years ago to the covering agency. A six hundred-pound bag only 110 pounds to the finer inch—six times as much as before. The six hundred-pound bag only 110 pounds to the finer inch—six times as much as before. The six hundred-pound bag only 110 pounds to the finer inch—six times as much as before.



Long belt drives are often unnecessary and extravagant. Messico Short Center Belt Drives do better work and permit of important economies in space, elimination of power waste through slippage, length and width of belt, and wear and tear on bearings.

Install Messico Drives wherever two pulleys can be placed conveniently on close centers. This policy will give you much greater freedom in placing your various machines.

Messico Drives may be installed vertically or in any other position. We submit designs and estimates for any type of belt drive on short centers.

Write for Bulletin No. 100, illustrating and describing our Messico Short Center Belt Drive.

Messico & Gottfried Company

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WHEN THEY WANT THE HIGHEST CLASS PLANING—

Hardings Bros.—manufacturers of Printing Presses—perform their work on Whitcomb Second Belt Drive Planers.

Everyone knows the extreme accuracy and fine finish required on Printing Press parts—that is recommendation enough for Whitcomb planers.

For eight years this company has used Whitcomb planers on all kinds of regular production and also special work—always with the same exceptionally fine results.

YOU CAN GET

the same results on most class of work within the range of Whitcomb Planers.

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From diagram to show DEEP GROOVE BALL BEARING carrying maximum load in a forward direction.

From diagram to show DEEP GROOVE BALL BEARING carrying maximum load in a reverse direction.

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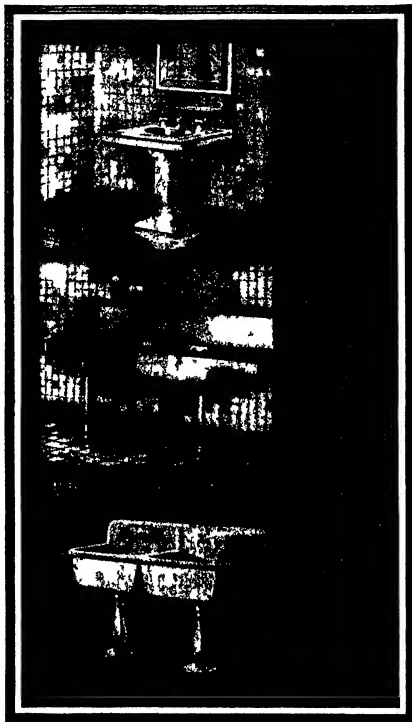
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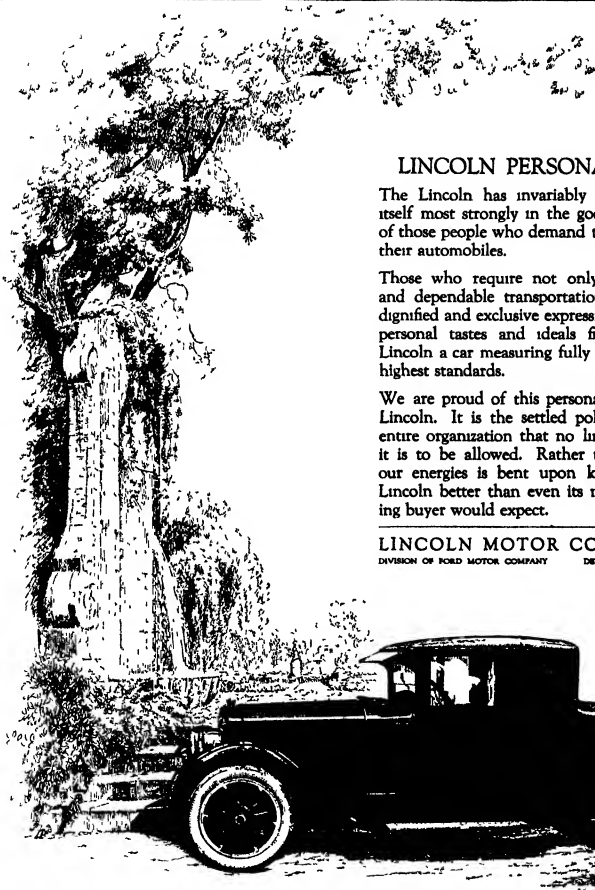


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DETROIT, MICHIGAN

L I N C O L N



SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, SEPTEMBER, 1923

THIS United States is a wheat-producing country, yet excellent; yet the value in 1922 of our entire wheat crop is but one-third that of the dairy products—milk and cream, butter, cheese, and the other things that come out of the milk cell. Cotton has been king, and will be again, if it is actually on the throne at the moment, but the easy staple produced on all our farms is worth barely

A Nation of Milk Producers and Users

and a select few 30,000 or more. The Department of Agriculture, making due allowance to the obvious fact that every farmer cannot have a herd of prize cows, believes that due attention to feeding and breeding would double the national average. A simple division of 11,000,000,000 miltons by 108,

giving his fair share. Our annual consumption of cheese, as might be expected, is far below that of many European countries, coming to only 17 pounds per capita. If we ate cheese with the Danes, English, Irish, French or Germans, we should have a market for nine billion pounds of milk beyond our present mark.

Wisconsin is the premier dairying State, having maintained the position since 1920. On January 1, 1923,

there were 2,100,000 milk cows in this State. New York and Minnesota came next, with 1,678,000 and 1,641,000, respectively. Illinois, Iowa, Pennsylvania, Ohio and Texas also have each more than a million cows in milk production.

Speaking of the condensed milk end of our dairy industry, it is of interest to learn that the annual output of cans, placed end to end, would encircle the globe not quite five times. To fill these cans requires the milk of over 600,000 cows. A year's production of canned milk, packed in cans, would duplicate the 10 pound of "cheese," which measures 405 feet from the base to the peak. A train 405 miles long would be needed to haul it, and one that a year's output of condensed milk. One year's output of condensed milk represented 2,001,000,000 pounds in the can, and 4,504,000,000 pounds in the raw milk state. Condensed milk contains 30 per cent milk solids, 10 per cent water, and 40 per cent cream sugar.

Evaporated milk is an sweetened milk, the reduction in bulk being obtained by the elimination of much of the original water content.

It is said that through the condensing and evaporating of milk we are saving in freight handling some 1,500,000 tons annually. Not only in reduced freight costs but in other ways the condensing and evaporating of milk has proved a great boon. In many parts of our country, particularly the South, milk is not obtainable in the fresh state and reliance must, in part, be placed on canned milk, which then becomes an indispensable feature of the diet rather

than an emergency measure. The symbolic Uncle Sam has been represented as serving in many capacities—marshal of the treasury, soldier, diplomat, agricultural agent, naval officer, and so on. This distinguished personage, it appears from the above figures, might better be shown with an apron over his clothes and a milk can in his hand. Of a truth, the philosopher was right who remarked that the human animal is a parasite upon the cow.



The figures bear out the cartoonist's idea of what the cow means to the United States



The distribution of our annual milk crop among its various uses, both in percentage figures and in pounds, is indicated in the above graphic statement

Dairy cattle in the United States number approximately 36,000,000 head. They are found on approximately 4,600,000 farms—70 per cent of our agricultural establishments having milk-producing herds. On the farm, milk and milk products for 1922 were valued at \$2,000,000,000; by the time they had reached the ultimate consumer they were worth more than three billions.

Our drawings show succinctly the distribution of this immense total, save that it does not indicate what is left for inclusion in the "miscellaneous" item. This goes into the manufacture of milk powder, malted milk, and other minor commodities, and allows also for the wastage and losses incident to manufacturing processes.

We have in operation—had when the census was taken—3,885 creameries, 358 cheese factories, 232 condensed milk establishments, and accounted thousands of concerns engaged in the distribution of milk, the manufacture of ice cream, and in other collateral aspects of the dairy industry.

The average milk production of 35,000,000 cows that are being milked in the United States today is 4021,400,000 pounds per year. At showing what breeding will do, many animals yield 15,000 pounds, a number 30,000,

000,000 people will indicate that we produce 100 gallons of milk for "each man, woman and child. Of this, we drink seven and a half quarts per capita than we did in 1914. Our city dwellers drink, or use otherwise on their tables, an average of a pint of milk per capita per day. The individual ration of butter throughout the country was 18 pounds for the year, and any reader who did not eat 2 1/2 gallons of ice cream in 1921 was not



Here is the practice known as "dealing around." The dealer has slipped back the top and is ready to put at the bottom and to strain the top.

Continuation of the "dealing around" manipulation. Here the dealer is seen pulling out the "second." This is done with extreme rapidity and is generally not noticed.

The "raised deal." The dealer is raising the cards as he passes them out, so that his partner directly opposite may see what goes into every hand.

Some tricks of the crooked dealer which take card playing out of the game-of-chance category

layer of fancy-sleight fingers just under the box lid, in case any curious customer or dice player might ask to be shown. This magnet derives its power either from a series of dry cells or from a connection with the lighting circuit, the latter being the field refractor. The magnet is, of course, so raised that it is directly under the glass top and magnetizes a field perhaps 4 x 8 or 8 x 8 inches in diameter.

The rest consists of a foot lever switch and a set of electro-magnetic dice. The lever of the cigar store stands in such position that he always dumps his dice on the magnetized field and naturally throws the high and winning faces. The moment his opponent throws, however, the dishonest merchant lifts the foot switch and the field is no longer magnetized. The percentage in favor of the man at the switch is very great. Nobody but a professional gambler is likely to suspect the device and such worthies are unwelcome intruders in dens of this sort.

Cheating at cards is a subject for long and scholarly investigation. Probably their marking originated with the Chinese who invented them, many centuries before they reached Europe. Speaking broadly, there are two methods of crooking cards—marking their backs so that the keen-eyed gambler knows what every player holds, and trimming the edges in various ways to assist in crooked dealing. Marked cards are called readers, those trimmed at the edges come under the general classification of strippers, though some are not trimmed for stripping but for high and low cutting. These terms will hardly need explanation among card players.

Marked cards can be and are being made in scores of ways. There are, first of all, the ready-made reader cards which can be had from the same manufacturers who turn out the crooked dice devices. They are made up in an almost infinite variety of patterns with almost invisible markings, such as a slight slanting or darkening of a line or figure at certain places, to indicate, ones, threes, fives, sevens, jacks and tens, the important cards for poker. But the cleverest gamblers usually shun these patent readers for the reason that the next man may be as familiar with them as the gambler himself. Accordingly, the party takes their own readers in many ingenious ways. A pointed piece of silver-ware, wax or redstone pine, drawn across the back of a card

will leave a glossy trail which can only be seen when facing a strong light. The gambler sees it so that he is placed to see. Cutting the edge of a finger or thumb nail will, India ink enables the miser to mark important cards at the edges while he is playing. Sand, glow, emery, reds and acids are used to remove the glossy finish from certain portions of a card's back, and the sensitized fingers of the gambler thus reveal what he is giving to this man and that while he deals. When he comes to a deceiver card he holds it on top and deals the next card underneath in a very simple sleight-of-hand trick. His partner or he himself gets the good card and the next good one. In this manner he fills up hands for himself or his confederate.

Other ingenious ways of marking are, by a fine prickling of cards near the edge by means of a finger ring on which is concealed this fine point or "peg" during

use, enable him to see the faces of the cards as he slips them off, one by one, in dealing. Such tricks are old. The inventor of recent years has devoted himself mostly to the card holdout machines, of which there is a staggering variety. Everyone remembers the gambler who slipped an ace up his sleeve. But supposing you have this man outfitted with a concealed mechanism which takes the ace up his sleeve, into his vest pocket or into the vest or skirt front with magic swiftness and silence. Suppose such a machine is capable of putting down into the concealed hand of the gambler a "cold" deck exactly like the one with which you have been playing, at the same time taking the true deck up the other sleeve out of the other hand of the evil magician. Must I explain that a cold deck is one that has been stacked so that the cards will fall in a fixed order giving the sucker a big hand but the gambler a still better one?

Such mechanisms are known by various names which usually indicate their manner of operation. There are arm pressure holdouts, which operate by pressing the arm against a rubber bag concealed in the sleeve. Pressing the bag sends the hand of the holdout machine down the sleeve to grip or give up the desired card. This hand is always an ordinary steel clip, such as may be commonly seen in offices where large stacks of papers are to be held together. There is also the knee-press holdout. This is worked by means of cards concealed under the clothing and bowing through small vents in the trouser legs at the knee, where they connect. By spreading the knees a little the mechanism in the sleeves pushes down to receive or release the cards or the cold deck. Again we have the chest expansion or breast holding machine, which is made to expand and deflate the lungs. These machines are always operated by a gambler who wears his suit, which may be marked for its long and loose sleeves. Accordingly, many partly informed men refuse to play in a game unless all remove their coats.

But here again a little wisdom is a dangerous thing. The inventors who serve the gambler have in recent years devised a holdout machine which required no coat or long sleeves. Here is the official description by its inventor and maker:

(Continued on page 215)



Left: Dealing from the bottom. The dealer does not hold the deck in this position in rotation, but keeps the face down. In the illustration he is holding the deck up to show the manner in which a ten of clubs is got from the bottom again with extreme rapidity. Dealing strippers. The high cards are wide at one end and the low cards are narrow so that the dealer can strip out all the desirable cards by pulling the deck apart with the fingers along the edges, as shown.

Dealing from the bottom and dealing strippers

the cards along the edges with very slight finger pricks at bits or red, according to the color of the deck in use, the color being got either from soft red and blue pencils or from tiny pillows of color in the opposite vest pocket, touching spots on the back of cards with volatile oil which darkens the backs at the given points long enough to make them readable for the period of the game but disappear later through evaporation, touching the edges of cards at fixed points with a strong solution of gum Arabic, and many other methods.

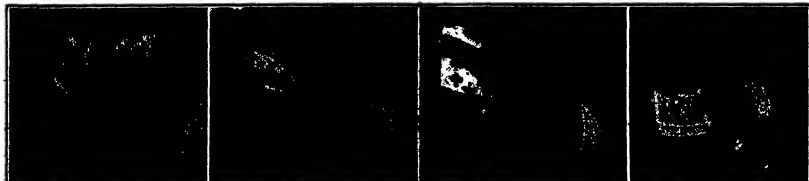
But playing with marked cards is only the beginning of the receiver which has been applied to this machine. The inventions used are almost as numerous as the ways in which they are used.

Little affairs or "shiners" cumulated at first to a pile which the gambler lays down on the table as he deals, or attached to a box of matches or to the table

under the clothing and bowing through small vents in the trouser legs at the knee, where they connect. By spreading the knees a little the mechanism in the sleeves pushes down to receive or release the cards or the cold deck. Again we have the chest expansion or breast holding machine, which is made to expand and deflate the lungs. These machines are always operated by a gambler who wears his suit, which may be marked for its long and loose sleeves. Accordingly, many partly informed men refuse to play in a game unless all remove their coats.

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(Continued on page 215)



Palming a card. The deck is held so that the top card may be slipped into the palm of the hand with the right thumb.

The card held in the palm is a natural and positive manner. The crooked gambler uses this hand freely without arousing suspicion.

How the dishonest hands of the crooked gambler serve him to good stead

Another instance of bottom dealing. The dealer is holding the deck in a peculiar manner to facilitate bottom dealing at his convenience.

One should always be suspicious of the dealer who moves back the top card. It is the first step in dealing second.



Electric light, running water, fireplaces, shower baths and free wood are among the things provided at the municipal camping ground in Pueblo, Col.

The merchants derive benefits which compensate them. A camp does often help to "put a town on the map," and occasionally visitors decide to become residents, while the guests at a camp often spend considerable sums in the town.

Space does not permit consideration of the camps of the entire country, and as those east of the Alleghenies are few, while those west of the Rockies are better known, we have limited ourselves to the central states through which motorists used to pass on their way to mountains or seashores, but in which they may now find lingering a pleasure. With 31 miles Kansas, approximately the geographical center of the country, as a hub with a radius of about 350 miles, we can draw a central circle which includes all of portions of twenty states of the Mississippi Valley, reaching up the high plains and touching the Rocky Mountain region. The following list of camps is located in this circle. Under each state heading the parts numbered (1) were obtained through questionnaires sent to the Commercial Clubs of two hundred towns, or camps personally enjoyed by the writer, while the parts numbered (2) were obtained from newspaper clippings, from people who had visited the places named, or from the literature of highway associations. The list as a whole cannot pretend to be exhaustive as the number of such camps is constantly increasing.

Wisconsin (1) Eau Claire, Madison (2) Abbotford, Alma Center, Ambler Junction, Augusta, Badin, Baraboo, Berlin, Birchwood, Black River Falls, Cambridge, Cuscowilla, Chippewa Falls, Clayton, Columbus, Durand, Elk River, Franklin, Frederic, Hudson, Hustler, Kilbourn, La Farge, Lake Marshall, Maunabo, Manitowish, Merrimac, Millers Lake, Nokomis, Peshigo, Portage, Port Edwards, Rice Lake, Riverview, Center, Sparta, Spring Green, Spring Valley, Waterville, Wilson, Wisconsin Dells.

Illinois (1) Deerter, DeKalb, Fulton, Madera, Peoria, Wilmington (2) Dixon, Ottawa, Springfield.

Indiana (1) Kentucky, Tennessee. No camps reported within limits set.

Minnesota (1) Austin, Bowles, Breck, Carleton, Lyons, Falls, Long Prairie, Mankato, Minneapolis, Montevideo, Red Wing, Rochester, St. Paul, Wells.

Iowa (1) Charles City, Charlevoix, Clinton, Council Bluffs, Des Moines, Iowa City, Keokuk, Lake Mills, Lyons, Marble Rock, Marion, Mason City, Mt. Pleasant, Sioux City, Tama, Vinton (2) Akron, Chandelwood, David City, Hawarden, La Porte City, Little Sioux, Missouri Valley, Nevada, Northwood, Onawa, Sallis, Shio, Westfield, Whiting.

Missouri Brookfield, Hannibal, Kansas City, St. Joseph, St. Louis (2) Bloomfield, Breckenridge, Cameron, Claridge, Dutton, Farmington, LaCrosse, Macon, Osborn, Parker, Rich, Sikeston.

Arkansas (1) Marietta.

Louisiana (1) Shreveport.

North Dakota to camp reported within circle.

South Dakota (1) Deadwood, Mitchell, Rapid City, Spearhead, Sturgis (2) Aberdeen, Alexandria, Bridge, water, Canton, Chamberlain, Cottonwood, Ouster, Sney,

Fairview, Hot Springs, Hudson, Huron, Kadoka, Kennebec, Kimball, Lead, Mt. Vernon, Minnehaha, New Underwood, Okmaha, Piedmont, Plankinton, Preble, Pukwana, Quinn, Redwood, Sioux Falls, Virgil, Wall, Wasta, White Lake, Whitecourt.

Nebraska (1) Chappell, Columbus, Fremont, Gilman, Guthrieburg, Grand Island, Kearney, Lexington, Lincoln, North Platte, Omaha, Sidney (2) Central City, Elm Creek, Yates.

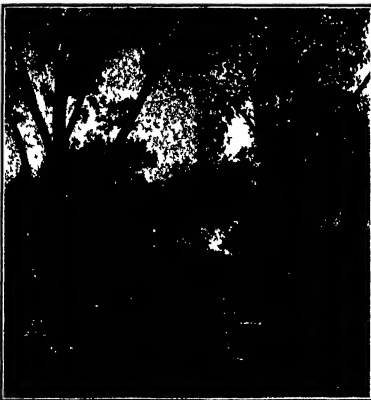
Kansas (1) Abilene, Baxter Springs, Coffeyville, Elmore, Garden City, Hiawatha, Highland, Larned, McPherson, Manhattan, Marion, Pittsburg, Salina, Wamego, Wichita, Winfield (2) Dodge City, Great Bend, Hutchinson, Junction City, Lytle, Newton.

Oklahoma (1) Guthrie, Miami, Okemah, City (2) Clinton, Granite, Shawnee.

Texas (1) Denison, Ft. Worth (2) Wichita Falls.

Wyoming (1) Cheyenne (2) Douglas, Laramie, Lusk, Ruidoso, Torrington, Wheatland.

Colorado (1) Boulder, Canon City (2) Colorado Springs.



Driving through the camping area at Overland Park, Denver.

Denver, Florence, Ft. Collins, Greeley, Laramie, Fairview, Pueblo, Rocky Ford (2) Herndon, Hiram, Lyons, Burlington, Orange Creek, Del Norte, Holly, Lamar, Las Animas, Leadville, Limon, Loveland, Great Springs, Salida, Sheridan, Lake Sterling, Triad, Vail, Victor, Wellington, Westcliffe, Wetmore.

New Mexico (1) Las Vegas, Raton.

Thus the automobile tourist is assured of camping space along his route through the central states, and, ultimately, in all states.

Schoolroom Ventilation

THAT a well designed but simple arrangement of a window ventilation is the most promising method for classroom ventilation is the striking conclusion reached by the New York State Commission on Ventilation.

The commission made a careful experimental study of the effects of atmospheric conditions on health and efficiency carried on in a specially constructed chamber in the college of the City of New York, and conducted a practical survey of the ventilating systems in use in the schools of northeastern Massachusetts, New York City, Minneapolis and other cities.

The commission found that while window ventilated rooms have a complete air change than fan ventilated rooms this reduced flushing was not obtainable. It was found sufficient to suppress the accumulation of odors and it permitted the maintenance of a cooler air condition which the physiological and psychological experiments of the commission had shown was more

favorable for comfort health and efficiency. Furthermore window ventilation did not tend to produce that uniformity of air currents and temperature characteristics of fan ventilated rooms which was found to exert a definitely harmful effect on health by promoting susceptibility to disease and afflictions of the air passages.

In schoolroom ventilation the commission emphasizes the need of careful temperature control, the temperature not to exceed 70 degrees, the use of window reflectors to prevent drafts and adequate gravity exhaust ducts not less than eight inches in diameter. The use of suction fans in the exhaust ducts was found to militate against the success of the system. The commission found that the average Wisconsin most agreeable temperature was 67 degrees.

While well devised and controlled systems of fan ventilation with windows closed were found capable of producing excellent results certain characteristics inherent in this method made them definitely inferior to a good system of window ventilation. Where used however, the commission found it necessary not only to have adequate provision of fan motor, duct and register equipment but also to control unseasonably and individually the temperature and volume of air supply in each room.—Abstract from School and Society for January 27, 1923.

Fighting the Corn Borer

MORE than 1,000,000 individuals of an important pest of the American corn borer, *Heliothis virescens* Wesm., have been successfully reared and released in the densely infested areas of New England.

It was believed by entomologists of the United States Department of Agriculture that it might be worth while to attempt to introduce it into the badly infested areas of southern Ontario. Following a suggestion to this effect made to the Dominion entomologist, authorization was recently given in the Canadian government for an assistant for this purpose. This entomologist recently visited the laboratory at Arlington, Mass., to receive instruction in the technique necessary for handling the parasite.

"A Small Private Laboratory"

Some General Impressions Gathered During a Visit to the Riverbank Laboratories

By Austin G. Leacorbourn, Mem. A.I.E.E.

OVER THIRTEEN AND FIFTY acres of rolling country overlooking the picturesque Fox River and dotted with various kinds and sizes of buildings, over one hundred contented men working with the zeal of the true scientist engaged in the work which lies closest to his heart: a vast array of all manner of scientific equipment in the hands of skilled technicians, a quiet, cheerful, healthful atmosphere conducive to creative activities, and, last, but by no means least, time, time, and still more time, that is so necessary in solving answers to scientific problems which have long baffled an altogether too busy world—that in brief, sums up the broad impression of how a remarkable man has realized a remarkable idea.

The basis of this story is that stretch of country between Batavia and Geneva in the State of Illinois, some forty miles out of Chicago. The remarkable man is Colonel George Fabyan. His remarkable idea is fully materialized form, is known as the Riverbank Laboratories. And the reason why you have not heard of these things until now is due to the extreme modesty of Colonel Fabyan, who has always made it a point to do things rather than to talk about them.

Where Utility and Architecture Meet

On arriving at the Riverbank Laboratories, one is immediately confronted by a group of odd buildings. In deed, the immediate impression is one that is about to engage in a brand new kind of experience, and subsequent developments confirm that first impression. The buildings have apparently been constructed with but one thought in mind, namely, maximum utility. Conventional architecture is a low cost aside.

Particularly as regards one of the buildings, the bizarre features of a skyscraper effect due to such successive floors being considerably smaller than the floor below it. In this instance the second floor is surrounded by a concrete terrace which, in reality, the roof of a goosy portion of the ground floor while the third floor is surrounded by a similar terrace which is the roof of the second floor, and so on. The general effect is not unlike the tower structures erected in children with their arms wadded thick.

The Colonel knew what he was about when he planned buildings of this type. In the first place, the various floors have considerable terraces which may be reached by doors. Then, when it is in order to provide additional floor space in any floor it is only necessary to build the necessary concrete walls, as well as concrete stairs for the additional seating and the job is completed. Thus a laboratory building of this type keeps up with developments in much the same manner as the well-known business idea.

Other Riverbank buildings are constructed with wings and towers and other irregularities always with the permanent purpose of providing the maximum utility. The author does not happen to have a complete list of buildings, but it is certain that there are at least a dozen other laboratory buildings, together with human labs and barns and garages and tool houses spread out over the vast tract.

So much for the buildings externally speaking. Upon entering the first of these buildings, we are struck by the vast array of equipment. Here is a mechanical laboratory equipped with lathes, drill presses, automatic saws, strengthening machines, and so on. We are conducted to a corner of the building where a curiously mounted electric motor driving a countershaft by means of a leather belt and various pulleys, and surrounded by delicate testing devices, illustrates the mechanical problem on the scientific operating table.

The problem proved to be a test of the relative wind friction resistance of two different types of blades with their spokes or webs exposed and the same blades with disks that cover the spokes or webs and thus reduce

the wind friction. Off hand, even the most experienced among us would probably dismiss this wind friction possibility as being quite insignificant and not worth the bother of experimentation. But not so with Colonel Fabyan, who, although not a scientist himself, has the happy faculty of looking for probable scientific developments in odd corners where none are believed to be possible.

So the Colonel turned his staff on the pulley problem some time ago and immediately the experimentation has proved most promising. The author was shown an alternating current motor suspended on ball bearings, the axis of suspension being coincidental with the axis of the motor, while the motor shaft was counterbalanced so as to remain in any position to which it was rotated on its bearings. A spring dynamometer was connected with the motor shaft, and the speed of the driven pulley was obtained by means of a speed indicator. The amount of mechanical energy consumed was estimated with great care. The wooden pulley was then closed at its open ends so as to cover the spokes and webs, and the tests were repeated. Measurements indicated that considerably less power was required to drive a pulley, and the operation was approximately the same.

This demonstration has established the surprising fact that considerable power is now going to waste in our large shops where power shafting and transmission pulleys are still used instead of ball pulley motor drive. One pulley alone may show but

SOME time ago we received a letter from one George Fabyan of Chicago, which read in part as follows: "I have a small private laboratory which is maintained by me for the purpose of investigating that which interests me. It is not a commercial laboratory and I am not interested in securing publicity either for myself or the laboratory. There are, however, several experiments which would undoubtedly be of interest to the SCIENTIFIC AMERICAN and the public."

Well, we have visited the "small private laboratory." It proved a surprise party. In the accompanying article, our Managing Editor tells what he saw during his visit to the Riverbank. And having established this acquaintance with the Riverbank and its character, our future issues will contain studies now being conducted by that institution, in greater detail.—THE EDITOR

a small loss, but when this loss is multiplied many times in a large plant, it becomes appreciable especially during these times of high fuel costs.

Delving Into the Mysteries of Sound

Other experiments are being conducted in the mechanical laboratory, for it is obvious that mechanics figure largely in any problem that is being investigated, not to forget the machine shop work connected with general experimentation.

Leaving the mechanical laboratory, we pass on to the sound testing building, which is known as the Wallace Clement Sabine Laboratory of Acoustics. It appears that this beautiful laboratory was built for the purpose of the late Professor Wallace C. Sabine, Harvard University by Colonel Fabyan, his friend. This laboratory is a three-story structure of brick and concrete, containing a building within a building, as depicted by our staff artist in the drawing on the facing page.

It was Professor Sabine's wish to produce a building in which all sound from one portion can be completely excluded from another portion, excepting as it passes through a wall where transmission is being studied. It was no simple matter to effect this special condition, for sound is an elusive thing which escapes from one confined place to another by various minute means. But the application of great skill and imagination to the problem was finally solved to the complete satisfaction of everyone by Mr. B. B. Kinschower of the River-

bank Laboratories staff, backed up by the keen personal interest of Colonel Fabyan.

The acoustic laboratory consists of two entirely separate structures, each of which is completely isolated by referring to the accompanying drawing that the inner room or sound chamber is completely insulated from the outer so far as sound transmission is concerned, having its own walls and its own foundation. The sound chamber, which is below the level of the ground, is entered through steel doors as well as a heavy sound proof door that makes the use of a large refrigerator. The sound chamber presents a spectacle of utter nakedness, due to its huge size and height, with plain floor and walls and ceiling. There are a few furnishings in the room which are all but lost because of the spaciousness. In one corner there is an entirely mystic atmosphere. In this corner there is a battery of organ pipes ranging from the little fellows with high pitched notes, down to the great crackling ones which roar their low notes until everything seems to quake with fear. Diagonally opposite, there is a queer cabinet with hinged doors forming the sliding top, said top having a hole through which protrude the head of any person who sits in the chair within the cabinet. In the rear of the room, some distance above the floor, there is a pair of steel rollers which turns slowly in the vertical axis and serves to change

the interference system and give a uniform distribution of sound intensity throughout the room.

With nature of the room in this? It is almost impossible to tell. In this corner, steel after the third wheel is spoken the air is stirred by the wind, with the persistent echoes of the first two echoes, so that one is almost sure to hear what has already been said. To speak still louder does not help matters, because a moment later the

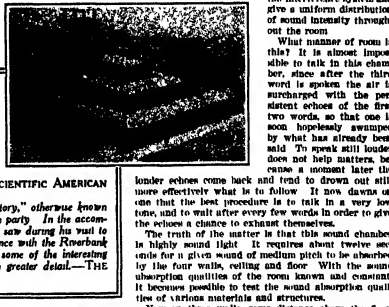
louder echoes come back and tend to drown out still more effectively what is to follow. It now dawns on one that the best procedure is to talk in a very low tone, and to wait after every few words in order to give the echoes time to exhaust themselves.

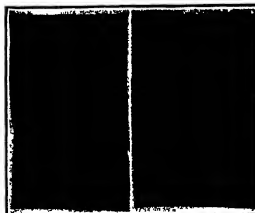
The truth of the matter is that this sound chamber is highly sound tight. It requires about twelve seconds for a note of sound which enters the chamber by the four walls, ceiling and floor. With the sound absorption qualities of the room known and constant, it is possible to test the sound absorption quality of various materials and structures.

Now on three walls, some distance above the floor, there are three sets of sound absorbers. These test panels may be built up of any material or type of construction to be tried out for sound absorption and sound conductive. When a panel is in position, its steel door is swung out of the way to expose the panel to the sound waves. The observer sits in the cabinet with just his head protruding, because it has been found that clothing has a marked effect on the absorption of sound waves. Within the cabin, the observer has a board with numerous push buttons in order corresponding to that of the organ pipes. Thus the observer can connect a switching device with any desired pipe. The switching device consists of a button which is pressed to start the organ pipes, and which starts a stopwatch movement the moment the button is released to stop the organ pipes. The observer listens carefully until the organ note has just become audible, and again presses the button, thus time stopping the watch and obtaining a reading in seconds and fractions of seconds. Obviously, this reading indicates what effect the test panel has had on the sound absorption qualities of the room, and makes possible the compilation of invaluable scientific data covering the sound absorption characteristics of various materials and types of construction.

So much for the sound absorptive experiments. The same arrangement is also employed for sound transmission experiments, as in the case of the rooms for our apartments and homes and office buildings. It

(Continued on page 161)





Instead of spraying the latex into a house fabric by means of a widely used nozzle and then hammering rubber over the whole the cords are coated in rubber milk and dried while in a position of perfect parallelism. The cords and the rubber become an integral mass and separation of the two which is the usual cause of a tire's disastrous cracks occur, while the strands are perfectly distributed over all of the cords.

A contrast between the old and the new methods of making cord tires

A NEW process of making rubber, wholly different from that of present times in the rubber industry, much less expensive, altogether faster and simpler, threatens radically to change the entire process of rubber manufacture. It is a dream of rubber circles and polytechnists come true. It represents years of research and grappling for a wholly new method of converting the solid content of the rubber milk into elements as well as physically pure rubber in such a practical workable manner that the difficulties involved in the process of present times shall be done away with. That method has been discovered. It has been tried and found not wanting. Not only that, but it makes better rubber than the older process—a stronger grade that is more enduring against age and wear.

The new process is so utterly simple and so little involved with technical and expensive lore that any man knew why it was not thought of long before. But kind night is easier than daylight while the greatness of simplicity is fundamental.

In making rubber by the Hopkins process the latex with rubber milk, known to the trade as latex, arrives at the factory in tanks and is atomized by a simple centrifugal device. Telling to the floor through a suspended atmosphere the spray is dried instantly making a miniature diskette of flaky flakes and building up a drift of uniform, it stored, unoxidized, colored, specific rubber resembling baker's dough.

Rubber is made in three ways. The milk latex of the tree is coagulated on the paddle of the Amazon Indian. Or it is coagulated on the identitons in pans by the addition of acetic acid and made into solid rubber in several stages, requiring the use of heavy rollers and several cleaning processes. Thirdly, it is made by the new latex spraying process. This process is fully controlled by patents owned by a prominent rubber manufacturing concern, but these patent rights probably will be leased to all other rubber makers who wish to use them.

Annually in the world about 225,000,000 gallons of rubber latex or rubber milk is made up into about 250,000 tons of rubber. Approximately ten per cent of this product comes from Brazil. The rest comes from the Far East. When we think of the source of the world's rubber supply we are quite sure to think of the dense, verdant slopes of central Brazil. It is here that our schoolbooks told us rubber was produced by the native Indian who dipped his paddle into the white

latex and held it in the smoke of a small open fire until the milk coagulated. Now the Indian of the Amazonian makes it still, but how the bulk of the rubber-growing industry has within recent years shifted to Malaysia, is an interesting story which has to be told, briefly, in order to prepare a background and to make more evident the contrasts with the new spraying process that has just been put on a practical working basis in the rubber world.

Rubber comes from the juice of several varieties of trees, but for practical purposes it will do to say that Hevea brasiliensis is the tree that furnishes what we know as real rubber. There are several other vegetable sources of rubber, or near rubber, such as the unrelated African rubber that produces a rubber called by the trade "latex" and which is somewhat inferior. Hevea brasiliensis grows wild in the tropics, especially in Brazil, but it has also been very successfully put under inter-

mediate lot of bécure and as the impurities may run from leaves and dead bark to seed and gum, are separated and the latex is to be treated differently before it enters the finished product, such as the tire you buy. Formerly the Indian found it easy to incorporate a few stones with the latex, adding to its weight without adding to the work. But the buyer has learned to look for such adulteration as a rule, chosen by chance and the Indian has learned that the knife is too apt to meet with his peddling of rock.

Plantation rubber could be grown in Brazil, provided the white man would be willing to die with fever and provided the native could be prevailed upon to work after he had earned enough to buy him the few things he wants from civilization. But it is healthier for the white man in the Far East, and the native supply of labor, none too energetic, can be had out by the Chinese who are found all over Malaysia and who are very intelligent and industrious.

Moreover, rubber can be grown more cheaply in Malaysia than Brazil. It may come as a surprise to some who well remember geography lessons of their school days that nearly all of the world's rubber comes today not from Brazil, but from the Far East. The Amazonian continues to produce about the same old rate, but the automobile tire industry has called for greater expansion than could accomplish. The Far East rubber is all grown on plantations in the Federated Malay States, Straits Settlements, Ceylon, Sumatra, Java, Borneo and Indo-China.

The rubber of Malaysia is treated by the coagulation process. This process has nothing in common with the process of the Indian and his smoky fire. Neither is a large amount of labor required. (Continued on page 163.)



The rubber latex is received from Sumatra in a tankship is pumped into a tank and removed to the spraying tank. It is pumped into a reserve tank in the upper room of the concrete structure and is sprayed through an atomizer in the floor into the chamber beneath where it meets with air heated to 100 degrees Fahrenheit. This dries the rubber milk instantly and it falls to the floor of the lower empty chamber formed by the tapering portion of the conical structure in the form of rubber flakes. In the short portion of the tank the accumulated rubber is retained and held. Fresh milk can then be added. Pounds of sprayed rubber per hour and requires a new of only four men to operate it.

The spraying unit of the new Hopkins process of converting rubber milk as received in tankships directly into rubber

tree cultivation in the Far East. Scattered through the impenetrable and shadowy forests of the vast Amazon basin are found the millions of wild trees which are scythed by the forest Indian, permitting the latex to ooze out. This latex is not the sap of the tree, for it has its sap in addition. Rather it is a white exudation from the lower bark or bast, and it is of about the consistency of country milk or city cream. It is not sticky. No tree ever flows more than a quart or two of latex, although many of the trees are large and it may with truth be said that the 225,000,000 gallons of latex gathered annually, including the part contributed by Brazil and Malaysia, is all collected in the latex analysis, by sprouting.

Having gathered a consignment of rubber milk, the Amazon Indian builds a small fire using for this purpose the native uprooted nut. When burned, these nuts give off the strongest fumes needed quickly to coagulate the latex. Into the milky latex the native dips his canoe paddle and holds it in the smoke of the smoldering nuts, turning it continually as the thin coating of latex dries into rubber. This process requires the drying off of about 60 per cent of the latex in the form of water vapor. Again and again the paddle is dipped and smoked until finally a ball or "bécure" about the size and shape of a large oval horse's head has been built up. The paddle is then removed from the center of the mass. True made, the bécures are brought on to the natives or Europeans who make their way into the wilderness to find the Indian.

The bécure made in the above manner is nearly black, owing to the smoking it gets. It usually contains other impurities in quite appreciable and annoying quantities, and as these quantities vary with each



From the reserve tank at the left the latex is run by means of a pump into the spraying tank. It is pumped into a reserve tank in the upper room of the concrete structure and is sprayed through an atomizer in the floor into the chamber beneath where it meets with air heated to 100 degrees Fahrenheit. This dries the rubber milk instantly and it falls to the floor of the lower empty chamber formed by the tapering portion of the conical structure in the form of rubber flakes. In the short portion of the tank the accumulated rubber is retained and held. Fresh milk can then be added. Pounds of sprayed rubber per hour and requires a new of only four men to operate it.

Instances of upper portion of the spraying tank, showing the spraying and air-heating apparatus



New type of lake and coastwise vessel of 2500 tons, designed to pass through the State Barge Canal

Sea-Going Ships for the State Barge Canal

Special Type of Barge Designed for Combined Lake, Canal, and Ocean Traffic

DURING the war we illustrated a new type of vessel, combining the qualities of a barge with those of an ocean-going ship, designed by Mr. McDougall, a veteran of lake transportation, which was intended to carry freight through the Great Lakes and the State Barge Canal to the Atlantic seaboard, and thence to such coastwise or foreign ports as might be desired. This first experimental ship was taken up by the Government and gave good service during the war. With the experience gained with this experimental vessel, Henry Deane of Cleveland, in collaboration with A. Miller McDougall, designed two improved ships of the same type, which are now being built at Detroit. These vessels are designed for operation through the Great Lakes and Welland Canal and the New York State Barge Canal via Oswego and the Hudson River, to New York and points along the coast. They are of full Welland Canal dimensions, with a length of 255 feet and a beam of 42 feet and a depth of 19 feet, and they are being built to meet the requirements of the highest class of the American Bureau of Shipping for Great Lakes and coastwise trade. Their service will cover the trade to the West Indies, the Gulf of Mexico and the Caribbean. When using the State Barge Canal, the ships will be loaded to a draft corresponding to a deadweight capacity of about 2000 tons, and at sea the capacity will be about 2500 tons. The ships have a full-length, double bottom, with storage for fuel oil and water ballast.

The vessels will be propelled by the electric drive, and the unusual feature is the system of control of propulsion units. The main engine will operate generators, whose current will be carried to electric motors, one on each shaft, which will be controlled entirely from the Pilot House, both as to speed and direction, by means of controllers under the hand of the officer on watch on the bridge. The main engines will run continuously in one direction at one speed. They will not be reversed or maneuvered, in fact the engine room stress takes no part in the handling of the ship. This arrangement gives extreme flexibility as well as constancy of control. There is the added advantage of the elimination of the racing of the propellers in heavy water.

The propelling machinery is of the Diesel-electric type, in which two six-cylinder engines are connected to electric generators as described above. In addition to supplying the main propeller motors, the generators also supply current for the auxiliary machinery, such as pumps, windlasses, capstans, sheaves, gun, refrigerating machinery, fans, lighting, etc. The living quarters are heated electrically; the galley range is of the electric type; the water for bath and other purposes is elec-

trically heated, even the white water is operated by a motor driven by steam or compressed air.

Refrigerated space is provided in two holds for about 500 tons of perishable cargo, the refrigerating machine, being in addition, to facilitate control of temperature as well as a measure of protection against failure. A duplicate system of fans and ducts circulates air through chubbies containing coils of pipe, through which brine at a very low temperature is pumped, the chilled air being then driven into and through the refrigerator coils. Perishable cargo such as dairy products, for example, can thus be maintained at proper temperatures at all times and delivered at destination in perfect condition. The advantages of this arrangement, as compared with rail shipments with slow movement and frequent delays, will be apparent.

Commodious quarters are provided for the crew. The master, mate and deck crew are located forward, and the engineers, stokers and stewards aft, with berths and bunks for all. There is a three-story hospital, and a fresh water supply has been installed in conjunction with the officials of the Public Health Service. As a safeguard against contamination, supplies for drinking and cooking are drawn only from certified sources and they are entirely separate from the abutment supply.

The clearance between the surface of the canal and

for lake service is by no means an ideal ship for deep sea work, we have always believed that it would be possible to build a special type, which, structurally would have the necessary strength for both services and at the same time would operate under no serious seasonal handicaps, either in the fall or on the ocean.

Are Bees Color Blind?

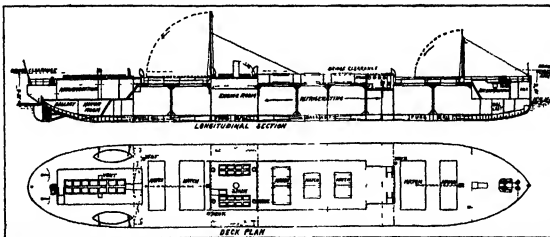
WHAT effect has color on bees and are these industrious insects able to distinguish between various colors? This question has been investigated a number of times. The importance of the problem may not be evident at first glance, but it is possible that the ability of the bee to distinguish between different colors may have a significant bearing on the attraction that flowers have for it. This again may influence on the production of honey in a particular way, for unless the flowers were of the proper color, the bees would not seek them out and gather the honey contained in them.

The bees were allowed to become accustomed to a certain color in such a manner that it indicated to them the food kept in small cups, which were arranged on paper of definite colors. Gray papers of different degrees of brightness, which must exert the same stimulus on the color blind eyes as colored papers, were used in the experiments for comparative purposes.

In order to exclude the sense of smell, the papers were changed frequently or they were covered with glass plates. Furthermore, in order that the sense of location should not be allowed to influence the bee in evaluating light waves, lengths were used. In order to avoid error, the food was stored, the position of the papers was changed from time to time. In the experiments colored papers, dried with pigment colors, colors extending over quite a range of wave-lengths were used. In order to avoid error, the food was stored, the position of the papers was changed from time to time. In the experiments, monochromatic light was used.

This was done by using a mercury spectrum on the paper from which the colors were screened off. The position of the same on the experimental table was repeatedly changed. The bees were allowed to become accustomed to this one color. Then the entire spectrum was thrown on the paper and the bees were permitted to discover themselves from the particular color which they had been originally broken in to.

It was found that the bees were able to distinguish easily and clearly violet light in blue and from green to yellow. Ultra-violet was also distinguished. The conclusion was reached that bees were able to recognize the colors in quite a wide range of the spectrum, a recent issue we dealt with the color blind aspects of several animals.



Inboard profile and deck plan. Length 255 feet; beam 42 feet, depth 19 feet. Deadweight capacity at canal draft, 2000 tons at full sea draft. Masts and smokestacks can be lowered in the Canal

the underside of the lowest beam structure throughout the canal is only 15 feet 6 inches—a fact which accounts for the absence of permanent masts and deck superstructures on these two vessels. The two masts above are hinged at the deck and can be quickly lowered. The smokestack and ventilators also are hinged and can be similarly lowered when passing under bridges.

Conservative shipping men, disdaining the possibilities of using ships of the Great Lakes for deep sea service, have declared that the ship cannot be done, for the reason that dimensions, proportions and scanting that are suitable for service on the lakes, produce a ship which is not suited for coastwise and trans-oceanic service. Although we agree that a ship built especially

Our Point of View

Politics in Engineering

ALTHOUGH it is a source of relief to engineers when the practice of their calling is hampered by the politician. Engineering is so serious and exact a profession that its members have no time, and less inclination, for that grotesque and unstable thing which we call politics. The study of physics and mathematics at college, followed by the construction of bridges, earth works, powerplants and machinery in its multiplied forms, serves to cultivate in the qualified engineer a perfect passion for cold facts, close reasoning, and straight forward procedure. The ethics of his profession, and its practice, bring in him a wholesome distaste for the slums and uncertainties of a political life. So far as the politician is concerned, the engineer asks only to be let alone, so that he may put the very best of his knowledge and experience into the prosecution of his work.

Hence it is that the recent removal of Mr. Arthur P. Davis from the position of Director of the United States Reclamation Service was produced positive consternation among the members of the engineering profession, for Mr. Davis is an engineer of high standing, who for an interminable period of forty years has proved himself to be an accepted and highly capable servant of the Government. Step by step his knowledge and abilities had raised him to the position of the executive of one of the most important governmental engineering enterprises in the United States. He was removed peremptorily. No adequate explanation has been given for the change, nor has he been afforded an opportunity for defense. His whole career of strong and disinterested partisan politics. Not only is the unavowed jealousy with which this distinguished and well proven servant of the public has been dismissed a matter of profound discouragement to the engineers of the country, but the reason which is given for the change is even more so.

The Secretary of the Interior gives as an explanation—*if it can be called an explanation*—that he wishes to place this great public work in charge of a business man rather than of an engineer, and without allowing a valid engineering control has failed, to merely abolish the office of Director, and creates in its place the office of Commissioner. This is more quibbling. Our leading engineers have ever been distinguished by great business and administrative ability. It comes as no surprise that one of the most distinguished and successful of the world's engineers in great works of reclamation given to a country banker who, we understand has also been a Government civil engineer. It is at once discreditable and discouraging, discreditable, because it betrays a great lack of courage, and discouraging, because it is a conspicuous instance of a movement to transfer the control of engineering works from practical engineers and place it in the hands of the politicians. The SCIENTIFIC AMERICAN has always contended that the interests of the country can best be served by placing engineering works under the control of engineers and removing them, as far as possible, from the baneful influence of the politicians, for these have almost invariably looked upon the responsible positions in such work as so many plums to be given to faithful followers of the party.

The attitude of the average politician to the engineer, and to all technical men for that matter, is one of contempt for the expert. This spirit is more often than not an expression of jealousy and dislike of the man who does not know for the man who does know. Residents of New York will not soon forget the contemporary our references of our distinguished Mayor to "this expert", and although such an attitude has no part, surely, in the motive which prompted the removal of Mr. Davis, the Secretary of the Interior cannot blame the intelligent element among the American people if they believe that this automatic elimination of an able executive from a great national work has been prompted by political motives of the most pronounced kind.

A World Timber Famine

A recent letter to the President of the Chamber of Commerce of the United States, the President of the American Forestry Association, Mr. C. L. Pack, draws attention to the warning of a world timber famine, which is given in the annual report of the British Forestry Commission General Levant, Chairman of this committee, is coming to the United States and Canada to ascertain what future timber supplies of Great Britain may expect from North America. In his letter to the United States Chamber of Commerce, Mr. Pack states that the threat of a timber famine affects not alone the British Isles but the whole world. The British forestry report states that there exists a widespread apprehension of a timber famine in the United Kingdom at no distant date. The demand for timber is constantly increasing, and the virgin forests are being worked out far more rapidly than was expected. Hence, the committee wishes to ascertain what reserves of continuous timber are available for import and how long they are likely to last.

It is evident that the question of the United States timber supply is a serious one not only for us but for Europe. In a recent article on "American Individualism and European Conservatism," it was stated that during the years 1918 to 1928 the ton miles of service in the transportation industry increased from 160,000 per cent to 240,000 per cent. The heavy industry going, it is estimated, 5,000,000 trees are cut down every year, merely to provide the poles to carry the wires over which pass the messages of industry, and that 200,000,000 cubic feet of wood are consumed every year in building and quarrying. These two items represent vast quantities, but they cover only a part of the field. We must add to them the enormous demands of the railroads for ties and structural material, and of the building trades for the construction of homes and factories. Another terrible source of loss, which annually cuts deeply into our forest reserves, is fire, which during a recent five-year period was responsible for the wiping out of no less than 50,000,000 acres of forest lands.

The conditions stated above are sufficient corroboration of the statement that, unless every possible effort in the shape of protective legislation and extensive reforestation is made, not merely Europe, but the United States itself, will ultimately be faced with a timber famine. Were the annual consumption a constant amount the situation would be serious, but because of the rapid growth of population, particularly in the United States, and the equally rapid expansion of industry, the consumption of timber shows an annual increase. These warnings of the American Forestry Association are no mere "howl of woe." The danger is only too real, and it approaches at an ever-accelerating pace.

Bombing United States Battleships

AN ATTEMPT will be made this summer by the Army Air Service to demonstrate that battleships can be sunk by bombing machines flying at a comparatively low altitude. Under the conditions "The Navy has turned over to the Army Air Service the two pre-dreadnaught battleships "Virginia" and "New Jersey," which it will be remembered, are among those which were destroyed by the Japanese in the Washington Treaty of Limitation.

Criticism was made of the sinking of the "Ostrich" two years ago, on the ground that the vessel was stationary and, therefore, unrepresentative in ideal target. In the present operation, the battleships are to be towed, and although their speed will not approach the modern battleship, the speed of movement is to be a knot, the targets will be towed at several knots' speed and the difficulty of registering a hit will be proportionately increased. On the other hand, there will be no defense by anti-aircraft gun. The experiment is in some measure for this bombing planes should fly at a height of several thousand feet. Special inter-

est will be attached to this experiment because the first use will be made of a new 6000-pound bomb containing 2000 pounds of T. N. T. So far as we know, this is the largest bomb that has ever been built. The aviators will attempt to drop it alongside the ship and set the fuse so that detonation will take place fifteen or twenty feet below the surface. If they succeed in sinking these two old battleships, the large area of the side of these old battleships will be blown in, and their sinking will be a matter of a few minutes.

Judging by their power of resistance to these brooding depth charges (for such they are) the "Virginia" and "New Jersey," being ships of earlier design, will be easier to put down than was the "Ostrichland." The "Virginia" and "New Jersey" were laid down in 1902, or some years before the dreadnaught period. The "Ostrichland" was not laid down until 1908 and great attention was paid to her undergar design, particularly with a view to preventing her flotation in case of injury by torpedoes. The test, therefore, will be more a test of the skill of the armor than of the resistance of the ships. We are of the opinion that if one of these 4200-ton bombs were detonated ten feet from the side of the "Maryland" and twenty-five feet below water, even that great ship, in spite of her elaborate subdivision and the provision of gas-expansion chambers, would succumb to the attack.

Dams Versus Droughts

ONE OF our busiest industrial centers is to be found along the upper Hudson River, upon whose banks are a great many of our largest cities and various industries, all of which derive their power from the flow of the river. Like all streams which flow in the mountains and elevated uplands, the flow of the Hudson is subject to great variations of high water, the manufacturers use billions of gallons of water flowing by to waste, whereas in the dry season the river becomes so low that many of the mills have to be shut down and thousands of employees thrown out of work. For nearly fifty years past both the State and various private agencies have been considering the advisability of storing up the flood waters and passing them down, gradually, during the dry season. Not only would such a plan prevent the periodical closing of certain factories, but it would result in the saving of some 2,000,000 gallons of water which have been burned during periods of low water to keep the larger and more important industries and power plants going. During the past half century many investigations have been made of this problem, and a plan of a scheme has been drawn up by J. H. Bargey, Engineer for the Board of the Hudson River Regulating District, a body created by the Legislature in 1921. The plan calls for the construction of sixteen storage reservoirs in the upper Hudson River watershed with a combined capacity of five hundred and ninety-three billion gallons. The execution of the work would take twenty years and its total cost would be \$200,000,000. Money is to be raised by assessing the communities and industries that would be benefited, and fifty-year bonds backed by these communities and industries are to be marketed. The plan is to be effected and develop at present a hydro-electric energy of 180,000 horsepower; but because of the droughts their continuous average output is only 85,000 horsepower. When the scheme is completed the engineers claim that the flow of water in the river will be continuous and that 140,000 horsepower can be realized in these plants throughout the year.

It is one of the advantages of such reclamation schemes that the damage done by frosts will be eliminated. The most severe flood in the history of the Hudson River was in 1814, and 1815, when the flow was over 300,000 cubic feet per second. Although the flow was over 300,000 cubic feet per second and about \$1,000,000 worth of damage was done to vast corn towns along the river. If the impact of the stream reservoirs (the plan) is carried out, the flow of the river is estimated that the peak of the flood could have been controlled sufficiently to prevent this damage.

Our Point of View

The Facts as to German Submarines

THE British Navy Department announces that it has received an authentic official report covering the facts regarding German submarines constructed and lost during the war. It reveals some four years of work in checking official records and consulting various members of the German Admiralty. In the first place, as to the total number of U boats built by the Germans during the war, the books of shipbuilding firms holding contracts show that 261 submarines had been delivered and 197 were under construction when the Armistice was signed. As to what became of all these and the men who manned them, we learn that the losses in personnel were 5594, of whom 515 were officers. Of the submarines, 87 were accounted for by depth charges, 36 by fixed mines, 20 were lost in fights with enemy submarines, engine and other troubles accounted for 14, destroyers, torpedo-boats and submersibles sank 15, 8 were lost through accidental ramming, armed fishing craft accounted for 6, aerial bombing for 6, and 6 were lost in submarine nets. In addition to the above, 21 U boats were demolished to prevent their capture by the enemy.

A study of the chart accompanying the report provides us with the geographical distribution of the losses, and we find that 50 boats were lost in the English Channel, 20 in the North Sea, 10 off the eastern coast of England, 10 were lost in various parts of the Mediterranean, 12 off the Dutch coast, 8 near Holland, 2 in Aegean flow and the remainder at widely separated points on the seven seas. The location of the losses as given above is about what the daily record of the war in the press would lead us to expect. The toll of ships to be credited to the various enemies of the U boats is something of a surprise. Thirty-seven boats destroyed by depth charges is about what one would look for, but that a nearly equal number were destroyed by fixed mines is surprising. If we remember correctly, even to ten of these were credited to the great sea barrage of mines stretching from a headland to Norway. Another surprise is that 20 submarines were lost in encounters with enemy submarines. It would be very interesting to know the particulars of these encounters, whether they took place above or above the surface, and whether the losses were due to gunfire, torpedo or ramming. The capture of the 13 U boats destroyed by torpedo-boats, destroyers and submersibles and those destroyed by depth charges should go together, in which case fast surface craft accounted for about 50 of the total of 137 submarines destroyed. It so, this establishes the claim of naval men during and since the war, that the most effective answer to the submarine is a fast destroyer carrying a heavy battery and a large supply of depth charges.

Super-Pressures in Steam Plants

IT WAS not so long ago that a pressure of 200 pounds per square inch was considered to be the maximum under which a power plant could satisfactorily be operated. High pressures brought with them difficulties in the way of heating jackets, etc., and the higher the pressure the more expensive the plant. It is so, this establishes the claim of naval men during and since the war, that the most effective answer to the submarine is a fast destroyer carrying a heavy battery and a large supply of depth charges.

The objects aimed at in this movement are to secure

a high thermodynamic efficiency and to secure that reduction in the dimensions of the turbines and steam piping which the great density of the high-pressure steam makes possible. That the steam engineers of the country are well satisfied with the results secured is proved by the action of an electric light and power company in Boston, where they are about to install a turbine plant in which the boiler pressure is to be not less than 1200 pounds per square inch.

As if this were not sufficient, we learn from *Engineering* that there is being built at the Williams Works at Rugby, England, a steam turbine whose boiler will be operated under the amazing pressure of 2200 pounds per square inch. Commenting upon this courageous venture, our contemporary draws attention to the fact that, since, as the pressure rises the steam becomes denser, and the water, on the other hand, less dense owing to its expansion by heat, there must come a point where the steam and water will arrive at a state of equal pressure, temperature and density, or to put it another way they will become indistinguishable from one another. This point is reached at a pressure of 3158 pounds per square inch and a corresponding temperature of 705 degrees Fahrenheit. At this point, also the water can be changed to steam without any surface of separation. The containing vessel may be solidly filled with water under this high pressure and temperature, and it becomes steam throughout its mass when the temperature is sufficiently high. The cycle of operation of the Rugby plant as calculated by Professor Callendar is as follows:

At a pressure of 3200 pounds per square inch and a temperature of 700 degrees Fahrenheit the volume will be 0.02 cubic feet per pound and the heat required is 320 British thermal units per pound. The steam is throttled down to 3000 pounds absolute and a corresponding temperature of 595 degrees Fahrenheit. It is then heated at 1500 pounds to 700 degrees Fahrenheit. The steam is then expanded adiabatically in a high-pressure turbine to a pressure of 250 pounds. The steam is then re-heated at 250 pounds to 700 degrees Fahrenheit, and then expanded in a second turbine down to a vacuum of 29 inches. The heat available for work in the two turbines is 671 B. T. U. and the total heat supplied is 1471 B. T. U., giving a total overall efficiency of about 38.8 per cent. The operation of the Benson turbine, so named after its inventor, will be followed with close interest by steam engineers.

Decline in World's Shipbuilding

THE dislocation of the shipbuilding industry by the war left the merchant marine of all countries in such a state of unstable equilibrium that even today, nearly five years after the close of the war, the situation is very confused. The enormous increase in the output of the shipbuilding yards, particularly in the United States, carried the world's total of shipbuilding to a point far above the demands for cargo space, even in normal times. Except in this country, where the shipbuilders decided to complete their war-building program, there was a more or less severe slump in building activity, and for the past few years the shipbuilding yards of the world have been in a rather bad way.

The last report of Lloyd's Register of Shipping covering the quarter ending June 30, shows that on that date the shipping yards of the world had a total of 2,290,000 gross tons of work, which is a decline of 500,000 tons below the figure for the previous quarter. The statistics of new construction show that Great Britain and Ireland lead with 1,588,000 tons, then in their order follow Germany, 852,400 tons, France, 170,000 tons, Italy, 141,000 tons, United States, 138,000 tons, Holland, 100,000 tons, Japan, 72,800 tons, French Dominions, 64,000 tons. It will be noted that Germany has the second place among the shipbuilding countries and that she is building twice as much new tonnage as her next competitor, France. This was to be expected because of the great depreciation of the

German merchant fleet, by the handing over of the largest and choicest part of it to the Allies as part of her reparations.

Comparing the above figure with those for the last quarter of 1914 prior to the war, we find that the United States yards were building 15,000 tons less during the last quarter of the previous year and the British yards about 400,000 tons less. Since shipbuilding affords a reliable index to world prosperity, it is evident that there is a long way to go before industrial equilibrium is again restored.

Seventy-five Years Ago

FROM the earliest days of railroad travel, the question of high speed has excited the public interest. Thus in our issue of September 9, 1848, it is recorded that a new engine, with 8-foot 6-inch driving wheels, pulled a train of five passenger cars carrying 250 passengers from Springfield to Hartford at the rate of 50 miles an hour, "the quickest trip ever made in this country with a heavy train over any railroad." Those were the days when English locomotive builders were in favor of large-diameter driving wheels for fast trains, and the Editor suggests that with larger wheels a speed of 50 to 60 miles an hour could be obtained. Our builders made the experiment, but soon returned to the 8-foot 6-inch driving wheel, which remained the standard size for 30 years or more.

That 75 years is sufficient to carry us back to the beginning of this history is realized when we read as follows: "The City of Providence is taking measures to light its streets with gas. The Almy Gas Light Company has commenced laying pipe and putting up fixtures. The pipes have been dug up and are badly lighted, and the inhabitants evinced great joy at the new way of illuminating."

And while on the subject of modest beginnings, take note of the following: "Very few railroads in this country can show greater percentage of increase in their receipts of the last six months than the Macdonald & Western Railroad of Georgia. From a statement just published, it appears that the total receipts for August, 1848, were \$12,478 and August, 1847, \$4,641."

The August editorial page opens with an announcement of the recovery of an immense bed of gold, 100 miles in extent, on the York and Feathers River, California. The gold is recovered by "washing out the sand, in any vessel from a tin snapper to a washing pan." The American people have been much interested in the mining nearly suspended, since both their sailors and captains, and not even \$10 a day would tempt laborers to return to the farms." All of which, by the way, sounds very modern.

Many of our readers are aware that the United States Navy, 75 years ago, made a survey of the River Jordan and the Dead Sea. As told by Lieutenant Maury, the story reads like a romance. Two metallic boats, one of copper and the other of iron, were transported over the mountains and launched on the Sea of Galilee. The latter proceeded "at will" in the regular way of its bottom made. The deepest sounding made was 1128 feet. There is nothing that the Navy cannot do. Well might the Editor exclaim: "It is a specimen of the refined system and discipline of the American Navy."

Very interesting is a letter in the September issue from Edwin Howe, Jr., of sewing machine fame, dated from London, which opens thus: "I am in the regular receipt of your valuable paper (through my father in Cambridge, Mass.), and goes on to give particulars of a French sewing machine which had appeared in an earlier issue. The letter proceeds: "I wish to say to your correspondent that I expect soon to submit a sewing machine which will strike and win in the same manner as his. It is one he has never seen. He has secured a patent in London to which he refers by saying that 'John Bull is thick upon some matters, and upon that seal is decidedly thick.'"

Bringing Order Out of Chaos

The Emergency Job of Reconstruction after Philadelphia's Station Fire

By William

A. McGarry

PROBABLY without parallel for sheer speed in executive execution was the engineering feat accomplished recently at Broad Street Station Philadelphia. That is in and out of that terminal of the Pennsylvania Railroad took up today at the vanishing remains of a roof of five blackened steel skeletons that one supporter of the latest art of steel roof in the United States. They are little figures of men as usual about with only necessity looking 150 feet in the air in cut away the twisted girders, cranes dropping them to flat cars and the latter moving in and out with no interruption in the regular train service. They probably counted at the efficiency of a system that can run a train a minute under such circumstances that the task today is relatively simple compared to what was done in three days after the train shed burned down.

Broad Street Station stands at the juncture of West Pine Square and Market Street. The Pennsylvania main lines run directly west from there on an elevated structure paralleling Market Street. Fifteenth Street it crossed by a bridge carrying the Pennsylvania platform just outside the station. The elevated structure is carried over all other cross streets by brick arches. The station office building is a seven to ten story brick structure occupying the space between Pine Square and Fifteenth Street.

Virtually all the space under the elevated structure between the cross streets is utilized by the railroad or allied service. The surface of the road was arched within the shed on the side which met in the main on a girder system. When that was built 20 years ago it was quite adequate to carry the rolling stock then in use. But on the occasion of the fire, the company found it necessary from time to time to strengthen the supports of the tracks. To that end steel and wooden posts and iron girders had been put under the old work. Beneath the concrete of the train floor was an arch of five heavy wood beams in front below by the ceiling of the main house, engine rooms a post office substation became a new one.

The whole paper the roof appeared to be of steel and glass there was quite a bit of timber in it and much rough and shabby inflammable material. The fire started at 11:45 p. m. on Sunday June 10th with a little of smoke, under the platform between tracks 11 and 12 and at that it seemed a simple task for the station men to check it. Within five minutes however they had discovered that the flames had gone down into the street level area below the train shed and within an hour 25 city fire-fighting companies had arrived and all the apparatus in the city had been shifted. It is that the burning of the shed disrupted telegraph lines and train starting systems and fire in the engine rooms had put out of service the locomotives for the operation of the station and nearly all other lines of the railroad system. The fire swept the whole length and width of the shed and in the area beneath the tracks and over the earthen platform crawled up the steel and brick walls and shot hundreds of feet in the air as it flared like a sea of fire of glowing steel.

The interior of the shed was almost entirely destroyed. The fire with smoke flames and melting glass in the most complicated and crowded tracks in the world got into such with switching engines often enough to drag out a string of sleepers bound for Boston and filled with sleeping passengers, arrived in the 11th the next morning. They also saved all but 12 passenger coaches and 12 freight cars. In the meantime the fire had jumped a hundred feet to Market Street to the upper floors of a steel skeleton which is to be a five-story building and burned out six floors of timber floor for concrete.

At that time when experienced forces were begin-



After the blast—a locomotive delicately balanced across a girder

ning to talk of dynamite to prevent a possible city wide conflagration, when fire was had been called out by a dozen skyscrapers when the station itself seemed doomed the work of reconstruction started. Over borrowed results called for men to go out for division engineers, superintendents, master carpenters, trainmasters and all sorts of technical experts also for section gangs and common labor. Heads of employment agencies and supply houses were routed out of bed at three o'clock to take orders for men and materials.

The first actual work of course, was the removal of debris. Shifting gears and section gangs became "smoke eaters" to do that handling red hot materials with all sorts of improvised tools at the very edge of the burning area, bearing up platforms still burning and otherwise making way for new construction. In the meantime other forces were preparing new schedules in use improved stations in various quarters of the city for the handling of passengers over the commuting lines.

By daybreak a group of men out beyond the fire curve near Seventeenth Street had gone to work on the brick retaining walls overlooking Market Street on one side and Dilbert Street on the other. In a short time it became evident they were constructing temporary viaduct ways. At about the same time shifting engines began to crawl over the network of tracks with loads of

shed was at its worst on Monday afternoon, completing the destruction of wires, compressed air and similar services. On Tuesday, however, 143 trains ran in and out. On Wednesday 161 were handled. Thirty-four enough trains had been streamlined to run 248, and on Friday and Saturday 275 trains were carried in the ruined station. In just nine days all main tracks were restored and ready for service, and 800 of the 1300 trains normally operated out of the terminal were running on regular schedule. It was not possible to bring in the others because it was necessary to free from four to six tracks for the reconstruction work.

More than 1400 men were employed on day and night shifts Monday, and that number was increased to nearly 3000 three days later, when the worst of the emergency task was concluded. All that has been described, however, was more or less simple compared to the accomplishment underneath the train floor in which every phase of engineering was brought into play. Before a single train could be run up to the gates it was necessary to replace the destroyed support timbers by the time the smoke had been cleared out of the shed. It was found that one locomotive had fallen partly through the concrete floor, bringing up in precarious balance across a few partly burned girders. The floor was not strong enough even for the locomotive's equipment.

Early on Monday morning the lumber yards were delivering timbers into the street and the danger area, and before noon a half dozen portable sawmills arrived. It was not then possible to invade the whole area under the shed and the system was laid into partly cooled and burned-out sections in order to shore up a track or two. After these—rather with them—went the electric lines and the telephone line on the north, and over the top of these were strung by derrick more than 400 poles. As soon as the ruins had cooled enough these were limbered and carried through windows into the terminal room.

On the list of electrical work would read like a catalog. Suffice it to say that in seventy hours after the first fire started the train starting system was reestablished with indicators on all the tracks, the telephone and telegraph lines temporarily shifted to West Philadelphia were operating out of the main offices in Broad Street, and all the other complex parts of the system were in working order in so far as wires were concerned. The power restoration was just as complicated. It was reported that the railroad runs computers' trains at two of its most important points, and that the electric power. For the convenient handling of these trains every track of the sixteen in the train shed had a set of overhead trolley wire, and naturally all of these came down, together with much of the side supports. Workmen stored them first on temporary supports, a foot at a time, following the smoke and later by the company permanent structures.

The story of how the old train shed is being removed is also of interest. It stood a giant and twisted skeleton after all the flames had been extinguished. The engineers had long realized that it could not be restored. Plans were drawn for a traveling platform to operate on four tracks, with the remains of passenger trains and of the umbrellas sheds which are to be built over the platform tracks. The remains of the platform ran on tracks 7 and 10. Tracks 8 and 9 being used to load and haul away the steel work, and the outer ends of the platform were carried on tracks 1 and 16. On the platform are derrick beams and other equipment to bring down the steel work. It is estimated that every piece of steel being hauled away with passenger traffic will have been removed within eight weeks of the day it was being hauled away. The steel work will have been completely along after the other reconstruction work.

General view of the wreckage in the Pennsylvania Terminal in Philadelphia, with the electricians patching up the nerves of the train-control system

cinders and timber, and a crowding force of carpenters got to work laying platforms right up to the edge of the burned section. Another gang wearing asbestos gloves started stripping everything loose from the train shed roof. In spite of the new fire rating underneath, the work was done. The work was done up to the train shed on that even on Monday morning.

Trains in and out of Broad Street Station. The rate of progress that may best be indicated by the number of trains operated. It should be borne in mind that the several fire burning underneath the



The Bureau of Standards test automobile, equipped for simultaneous determinations of important features of gasoline performance and car economy

This automobile engine may be tested in the laboratory, under ideal conditions, but it must run on the road under conditions far from ideal. When traveling along the highway at a speed of forty miles per hour, more or less, the behavior of car and engine presents so many aspects that, for their convenient observation, more observers would be required than could possibly be packed about the car. It is in this emergency that the inventive faculty is called into play; the Bureau of Standards has recently devised an apparatus that automatically and unobtrusively records the action of the car, in sixteen separate particulars, requiring at most the attention of one or two operators in addition to the driver. This makes it possible to conduct road tests on a basis never before dreamed of, as regards both accuracy and completeness.

The rate of flow of gasoline in an automobile engine is an index to the rate of energy input. Obviously, then, the first object was to find a suitable instrument for determining the flow of the gasoline. A flow meter was selected consisting of a vertical tube slotted parallel to its axis. A light plane moves vertically in the tube. Gasoline enters the latter at the bottom, flaring freely out of the slot below the piston into a ring-shaped space through which the position of the piston may be seen. The piston affixed to the piston, moving over a vertical scale on the outside tube, indicates the flow, the length of the slot, the flow of the gas, and the pressure, the rate is limited.

Preliminary experiments involved the use of photographic records secured by focusing an image of the scale and pointer of the flow meter on a moving film. The bulkiness of this type of flow-meter camera operated to a disadvantage, and the flow of the scale and pointer by means of shutters on a roll of bromide paper. Time intervals are controlled from a contact mounted on the circumference of the car, and these are impressed on the fuel-flow film by the alternating increase and decrease in the intensity of the illumination on the bromide sensitized paper.

How much energy or thrust does it require to move an automobile on a level highway, down hill, or up grade? The apparatus described replied to this question in terms of the power output of the engine. An accelerometer was employed, which is essentially an instrument for measuring the force acting on a "free body" to supply the latter with the constant increased velocity which is to be accurately determined. Such a device appraises the linear acceleration, positive or negative, of the automobile nose, and takes account both of the vehicle's and of the gravitation force.

The "free body" employed in the particular accelerometer used in these experiments consisted of a column of mercury mounted parallel to the wheel base of the untried vehicle. The gas element an unobstructed connecting tube, as well as the move above the closed end of the mercury column, were filled with a light oil. When the tube containing the mercury column is used only in an increased velocity parallel to its long axis, a hydrostatic pressure is exerted in the oil, thus balancing the force required to accelerate the mercury. This

pressure is recorded by a pen-arm affixed to the connecting element of the accelerometer, which when the spindle, which ordinarily is equipped with an indicating hand, is in this case provided with a small piston linked to a recording pen. This pen moves back and time lag and registers the average speed of the automobile during the preceding two seconds.

The many-sided, compactly-built, recording unit uses, for almost all its work, a single recording drum. Speed of the automobile, acceleration, velocity of the atmosphere current, direction of the wind, manifold pressure, water-coolant temperature, water-inlet temperature, oil temperature, carburetor-air temperature, transmission lubricant temperature, differential-lubricant temperature, weight of air used by the engine, fuel temperature, and air temperature are all graphed, in like varying colors, on a single strip of paper, moving at a non-variable speed of one inch of an inch per second. The paper supply is adequate for an uninterrupted service of one hour. The pen-arm, which is connected to a separate unit, a 12-exposure Kodak film being used for retaining the impressions.

The faithful observations of this hunched recording unit are all graphed, in like varying colors, on a single strip of paper, moving at a non-variable speed of one inch of an inch per second. The recorded observations are made on unruled paper and the readings are made by use of collimated lenses, mounted into position by reference points and lines, and marked with the calibrated pen-paths. The supply of paper, record roll, and the driving element, consisting of a motor and its removal for re-winding is possible without up-setting the tooling portions of the apparatus.

Little wonder is it that this test car, with its multitude of ramifications, should have been accorded a proud reception through the rural sections in which preliminary experiments were conducted. With the radio-telephone on the crest of its popularity, the off-hand conclusion of the spectators alongside the highway between Washington, D. C., and White Sulphur Springs, West Virginia, was that this automobile was equipped with a wireless and a radio-telephone.

The theory having long since been exploded, observers were now to observe the mechanism as a creation for fretting out moonshine distilleries.

The speed of the test automobile is determined by an ultraviolet tachometer, which when the spindle, which ordinarily is equipped with an indicating hand, is in this case provided with a small piston linked to a recording pen. This pen moves back and time lag and registers the average speed of the automobile during the preceding two seconds.

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Little wonder is it that this test car, with its multitude of ramifications, should have been accorded a proud reception through the rural sections in which preliminary experiments were conducted. With the radio-telephone on the crest of its popularity, the off-hand conclusion of the spectators alongside the highway between Washington, D. C., and White Sulphur Springs, West Virginia, was that this automobile was equipped with a wireless and a radio-telephone.

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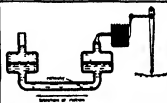
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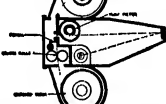
Sixteen-to-One Automobile Testing

Extraordinary Assembly of Apparatus for Making Many Tests on a Single Run of a Motor Car

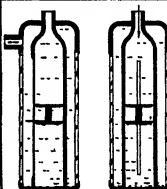
By S. R. Winters



Diagrammatic sketch of the accelerometer



The mechanism of the flow-meter camera



Structure and working of the flow meter

"The wind bloweth where it listeth," is a Biblical

proverb that is a necessary recognition in all experiments that would accurately reflect the conditions under which a motor propelled vehicle operates. Both the velocity and direction of wind are factors in the velocity of the car in action. Acceleration measurements, in the interest of accuracy, have to include the wind. The direction of the latter in relation to the movement of the automobile is significant because of the increase or decrease in the effective frontal area. The device, the Venturi, mounted three or four feet above the top of the automobile, and supported from the running board, measures the relative velocity of the atmosphere current. This null of the engine-performance testing apparatus is free to revolve about a vertical axis, and is maintained in the wind by vertical vanes in proximity to its exit end. The angle between the direction of the wind and wheel base of the motorcar is conveyed to a recording pen by the angular movement of a flexible shaft.

High-Altitude Mountaineering

IN THE Great Smoky Mountains, near Gatlinburg, Tenn.,

F. N. Flinch prevents none of his findings on the physiology of high-altitude mountaineering. Mr. Flinch has been making a study of the human body in climbing Mount Everest. Up to 21,000 feet the climber's physical condition was found to be generally unimpaired and good sleep and recuperation from fatigue were experienced. At 21,000 feet sleep was light, appetite fell off, and there was a general loss of physical strength. The acceleration is that at any, 22,000 feet acclimatization to altitude ceased and above that height rest should be used, at first in small doses, and from 26,000 feet in larger doses, but the dose must depend on the nature of the ground. It must also be remembered that oxygen increases with altitude, and as the proportion must be made for this. The stimulating effect of cigarette smoke was noted, and it was found that at greater heights than these were reached without the use of oxygen. Mr. Flinch thinks that this procedure was not a very satisfactory one. A man must become slightly acclimatized level a man must become slightly weaker and unable to recover from fatigue unless he makes use of oxygen.

The Trial Trip of the "Leviathan"

A Five-Day Test of the Motive Power, Equipment and Operating Staff

THE trial trip of the "Leviathan" took place over a distance of 218½ miles, on the course shown on the accompanying chart, and lasted from Thursday, June 18, to Sunday, June 24, starting from Boston Light, the ship moved around Cape Cod and, at Mattaket Light, held her course for Abaco Light, then passed through the Providence Channel to the Florida coast, and from Jupiter Inlet Light she ran on a northerly course for a 26-hour test at maximum power.

This was the third trial trip of the "Leviathan." The first took place in the North Sea, in the early summer of 1914, when she was starting from the hulk's lands, and, as in the recent test, she carried a large number of invited guests. The next trial was made after her heavy transformation into a transport for American troops during the war. The present lengthy trial was rendered necessary by the extensive overhaul of the main engine, the change of the boiler plant from coal to oil-burning, the complete reconstruction of a large part of the passenger accommodations, the reconstruction and refitting of the whole of the electric system of entirely new lighting, heating and plumbing systems, and the general reconstruction of the vitaling system.

All practical shipping men know that the reproduction and strain upon the operating staff of a large ocean liner increase more rapidly than the increase in the size of the ship, and they will agree that the decision to give this great vessel, upon her reconstruction, over \$5,000,000 had been expended on a successful trial, under conditions similar to those of a regular transatlantic passage, was a wise and necessary precaution. Although the most important trial was that of the motive power, a thorough test was made also, if every part of the equipment and of every department of the vessel. The reconstruction of the ship as handed out to the guests, called for the mingling out of the lifeboats by the crew, daily hot showers for the crew, the passengers assembled in the saloons, the use of fire drills with operations of the bow and closing of watertight dry docks, tests of the life-boat-deploying system covering the lifeboats, and the use of many of the powerful heavy searchlight of 4,000,000 candlepower on the forecast, and of wireless, star telegraphs, ventilating systems—297 in number—salt- and fresh-water sanitary systems, and a score of other elements in the makeup of a giant, high-speed liner—that most complicated of modern contraptions.

The plan of the trial called for a gradual working up of the power to her full capacity, and the operations of the propellers at the start, to the final operation of the ship at maximum power for a period of 26 hours. On leaving Boston, the trial speed was set at 130 per minute. This was maintained for 12 hours, the technical staff taking engine-room notes for the last four hours of the motive power test. The speed was then gradually increased to 160 and maintained for 12 hours, during which time the last four hours. Then for successive periods the speed was increased to 170, 175, 180, and finally to the maximum, with all burners going, if necessary, in any of the 46 boilers. It should be noted that the "Leviathan" is a White Star ship, which use the low-pressure White burner, the "Leviathan's" boiler plant is equipped with the Peabody high pressure boiler, and the trial was an excellent result of the trial.

There was fog on the first night out, and this caused the ship to fall some hours behind her schedule. She rounded Abaco Light about midnight June 21, passed at high speed through the Providence Channel, and in the early morning coasted the Florida coast, passing Jupiter Inlet Light about at 11 A. M., June 22, and, with everything well open, reached Diamond Shoal Light at 3 P. M. A. M. June 23, having covered the distance of 80 miles at an average speed of 27.80 knots. Full power was maintained until the "Leviathan" reached at 3 P. M. A. M. June 23, having covered the distance of 74.21 miles, when it was found that the ship had covered a distance of 687 miles in 26 hours, at an average speed over the ground of 26.4 knots, a splendid performance and a world's record for a continuous 26-hour run.

Now it detracts nothing from the merit of this performance to remind our readers that this does not mean that the "Leviathan" is a 27½ to 28-knot ship in still water. To get at her true speed, she must make a deduction for the speed of the Gulf Stream, in the ex-

istence of which she was running, and in addition must be made to her speed to compensate for the loss of power due to the high temperature, 85 degrees, of the seawater which was passing through her condenser.

A study of the current charts of the Hydrographic Bureau of the United States Navy shows that at the period of the year the Gulf Stream runs at a speed of 3½ to 4 knots off the southern coast of Florida and diminishes in speed as it spreads out to the northeast. The average speed over the 26-hour course, taking account of the high temperature, was probably about 2.77 knots. Deducting this, we got a speed of about 24.73 knots through the water.

On the other hand, if the speed of the Gulf Stream was a help, its high temperature of 85 degrees was a hindrance to the speed of the "Leviathan." The normal sea temperature is 65 degrees and that rise of 20 degrees played all sorts of mischief with the vacuum—and a high vacuum, to be remembered, is all important in developing the full power of a steam turbine. With sea water at 65 degrees the "Leviathan" would have shown at least 28 inches at the condenser, and this

once has shown that, in average weather, with propellers suitable to the ship's form, etc., the ship is about 10 per cent. Making a 10-per-cent reduction, we arrive at an average of 24.38 knots for the 26-hour run.

That the "Leviathan" was suitably equipped in her condenser which varied in temperature from 85 degrees at the commencement of the run to 65 degrees at the close, and this had the effect of putting down the vacuum to as low as 25.0 in being during the first few hours of the trial. The water temperature at 85 degrees it would have been possible to hold the vacuum at 28 inches, as was done in the cold water off Boston at the start, in which case about 0.9 of a knot would have been added to the speed. Thus we arrive at 25.24 knots as the speed of the ship through still water.

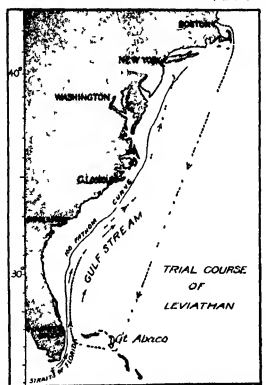
From these calculations we are led to the opinion that, in a series of runs, with and against the tide, in deep water, the "Leviathan" when she has been thoroughly shaken down, would be capable of making a speed of 25.25 to 25.50 knots over the measured mile. The "Vauban" (six feet longer and with two more boilers) has averaged 24.70 knots from Andrews Lake to Liverpool, hence we may look for a spirited ocean contest between these ships.

When we turn to mind that the "Leviathan" during the intervening ten years since her launching in 1913, had seen only about eighteen months of service, and that she had spent over \$5,000,000 in her rebuilding, it will be agreed that the fine results achieved in this trial are a great credit to the Olden Brothers, who laid out and supervised, and to the shipbuilders (Lynch) who executed the reconditioning and (in all fairness let us add) to the original builders of this ship.

Dynamiting Bedrock Over a Subway Tunnel

DYNAMITING over a subway tunnel under New York Harbor with only thirty feet of rock between the tunnel and the surface of the water, is a feat of which hundreds of thousands of people are daily being reminded without the slightest injury to the tunnel or to the subway trains which pass along its length at frequent intervals. Dynamite has been used in the bed of the East River, just above the old Brooklyn Bridge, and rises to within thirty feet of the surface at low tide. In order that the largest battleships may pass this point and enter the Brooklyn Navy Yard, as well as to permit the passage of the deep draft vessels now so largely in use in the mercantile marine, the channel must be deepened to forty feet. The obstructing roof of solid rock of a very tough variety, which is about 100 feet deep, was dynamited. It is of great advantage that it should be placed in holes drilled in the rock to a depth of ten feet. This drilling was done by means of a small saw on the surface of the water, and it is essential that means be provided for holding the saw rigidly in place when the tides and waves were running. The saw is better 12. The saw is equipped with vertical spuds, like a dredge, and those are projected downwards, and the saw is held in position by means of a heavy hoist, by means of racks and pinions moved by small background steam engines. It is possible to raise the saw bodily, not clear out of the water, but some distance above its normal level of flotation. For all practical purposes the saw is now no longer a saw, but a temporary platform on legs and the drilling may proceed with the assurance that the drills will not be thrown out of line above the hole. A battery of three churn drills, each with a 100-horsepower motor, is sunk in a depth of ten feet on ten foot centers. The saw or drill bit now backs away about seventy feet, the clearance of 80 to 100 per cent permits are packed into lengths of common galvanized iron leader pipe and these are lowered into the hole.

When the platform has been connected in series by the wires used for electric detonation, the charges are ready to be fired. Certain precautions must now be taken, in order to protect the safety of it is necessary to ascertain that no subway trains are in the section of the subway which is to be dynamited. This is made known by means of electric signals and by the use of a telephone system. Trains are prevented from entering the tunnel and the subway is kept open. The charges are fired. Surprisingly it has been found that so little tremor is felt in the neighborhood of the three feet below the floor of the roadway as to give rise to any of a place on the floor of the tube as a test trembles but slightly



Trail course of S.S. "Leviathan." Full-power run was made from Jupiter Inlet to latitude 26.23 north.

would have won an addition of 0.75 knots to her speed, raising it to 25.48 knots. If, at the end of the 26 hours, the "Leviathan" had turned and run back over the course, and the same conditions of no wind and calm sea had obtained, the current effect would have been eliminated, and the actual speed would have been determined with great accuracy. This method is used in all our warship trials over the measured mile at Rockland, the vessel being run alternately with and against the current, the mean speed, as thus obtained, being the actual speed through the water.

As a check upon the above calculations, in which the speed of the Gulf Stream is necessarily no more than an approximation, we have available the closely accurate method of determining the speed of a ship by the revolutions of the propellers. Applying this to the "Leviathan," we find that the pitch of her propellers is 14.68 feet, and that the average revolutions for the 26-hour run were 194 per minute. $(14.68 \times 194 \times 60 \text{ (minutes per hour)}) \div 60 \text{ (minutes per hour)} = 174.8 \text{ knots}$

Dividing this by the 2.77 knots we get the speed in knots per hour. But because of the fluidity of the water is driven rearward, in a variable proportion to the forward motion of the ship, this must be to certain corrections, is known as the "slip," and experi-

Keeping the Ash in Motion

Continuous Mechanical Discharge of the Unburned Residue, and Its Role in Boiler Efficiency

By David C. Spencer

ONE of the problems which constantly confront boiler room engineers and operators, is the matter of cleaning fires and discharging the ash. To the average layman, this may seem like a simple proposition. In the case of small furnaces where operation is carried on at manual rating or less, possibly the situation is not so difficult. But in these days of large units and continuous operation at high overtimes, the problem assumes an entirely new aspect.

Boiler operation may be classified in two groups. There is the station or plant whose load changes frequently, sometimes slightly, at other times in violent swings. The boiler may be delivering steam at 100 per cent of rating at one minute, and five or six minutes later be required to deliver 250 or 300 per cent of rating, with an equally sudden drop when the load goes off. Such experiences are not infrequent in central-station practice or in such industries as pulp and paper mills, rolling mills, power stations of coal mines, etc.

Then there is the station whose load is fairly constant for an extended period of time. Such changes as occur are gradual and can usually be anticipated. There are practically no sudden fluctuations. Instances of this class are, for example, the case of power companies operating two or more stations, one of which carries the reserve, while the others run at uniform rates. Among industrial plants a good example would be a shop equipped with machine tools or a spinning or weaving mill whose production is fairly steady.

In stations of the first classification, the operator's problem is to deliver steam when and in the quantity that is required by the various processes in the case of central stations supplying light to the community and power to the traction lines, a sudden storm for example, demands an instant increase in both the lighting and power load. This increase must be met and carried by the boilers. In the industrial field the sudden call for steam for process purposes, as for example valving in the rubber industry, mounts an equally sudden peak which the boilers must take. The operator's problem in such cases is, as has already been stated, to deliver the steam. To accomplish that he must have an equipment that is highly flexible.

The elements which make for flexibility are the reserve capacity of the stoker and the ability to clean the fire quickly and thoroughly, and that the cleaning period should be variable at the will of the operator. The reserve capacity of the unfired stoker is so well known as to call for little additional comment in this discussion. Suffice it to say that the mul-tiple-retort stoker with its deep fuel bed provides in the greatest degree the first essential element.

The power drop is without exception the most satisfactory method of cleaning fires where conditions exist such as have been outlined. It gives the operator absolute control over his fire. He can, if necessary, increase the rate of coal feed to meet almost any contingency that may arise. Every operator knows that the question of capacity is largely one of the amount of grate area that can be installed under the boiler. Once the operation of 900 or 1000 per cent of rating is not beyond the point of possibility, provided the boiler can be cleaned up to that point. But it would probably be unconvincing from a good many points of view because no stoker required.

The same control, however, can be temporarily attained with a much smaller stoker if the operator feeds the coal in at a high rate, turning the volatile and discharging a large proportion of the coke. Naturally

this would be very wasteful operation, but when the operator is confronted with the necessity of delivering a certain amount of steam or facing a shutdown, probably it would be the less wasteful course to pursue. Of course, in this an extreme case. A capable operator seldom gets caught in a jam which would require

will show why it is easily possible to perform this operation in less than half a minute. It is especially noteworthy that in such operation with the power drop, there is practically no interruption to steaming as the result of the cleaning period.

In the second class of operation the problem is entirely different. With a fairly constant load, the operator goes automatically, to operate his plant at the point of maximum efficiency. There is comparatively little need for the ability to clean fires instantly. Rather, there is urgent need for as nearly as possible clean fires at all times. The ideal way to maintain clean fires is to discharge the ash as rapidly as it forms—in other words, by means of continuous ash discharge at a rate proportional to the rate of combustion.

The most practical and satisfactory device for accomplishing this result is the rotary ash discharger which has been brought to a high state of perfection. One of its essential features is a deep ash pocket. This pocket must not be regarded as primarily a storage space for ash, but if that were the only requirement, an ash pit would probably answer the purpose.

It is extremely difficult to handle hot ash. After the ash has become cool, it can readily be broken up and discharged. The ash pocket serves as a space in which ash may be treated or conditioned for discharging. The conditioning of the ash is the most important part of the process. It may contain after it leaves the stoker, and the cooling of the refuse.

To provide this ash pocket is divided horizontally into two sections. The upper section is flanked by a grate somewhat similar to the extension grate of the stoker itself. This is the section in which air may be admitted in any desired quantity. The combustible which remains in the ash after it reaches the pocket continues to burn while in this section and this results in reducing to a minimum the combustible in the final residue and, therefore, in increased combustion efficiency.

The lower portion of the pocket is flanked by cast iron crusher plates. These provide a surface against which the clinker can be crushed. In all double-set arrangements of the stoker there are crusher plates on each side of the pocket. This is also true of single set arrangements where two crusher rolls are provided. When only one crusher roll is used, the crusher plate is on the stoker side of the pocket and the bridge wall side is lined with a rigid cast-iron plate.

The crusher plate is movable so that the gap between the plate and the roll may be adjusted to any desired width. This provides for crushing the clinker to any size suitable for easy handling by any ash disposal system. It also permits a certain degree of variation in the rate of ash discharge although this is a secondary function. Finally, it provides a means whereby the pocket may be cleaned when the stoker is off the line for cleaning or overhauling.

The crusher rolls are the operating element of this system of ash discharge. They consist of cast-iron shells mounted on a common shaft with a square cross-section. The shells are built up in sections for convenience and are armed with teeth that have a triangular cross section. These teeth are made of special cast iron which is very durable and are made ready to wear as much as possible. The teeth are such as to provide the maximum crushing force with the least strain on the rolls or mechanism.

The rolls may be operated the stoker drive or independently as desired. In either case provision is made for varying the speed of the rolls independently of the stoker to regulate the ash discharge rate.



Stoker in a Philadelphia power plant fitted with two-roll rotary ash discharger

operation of that character. But he frequently finds himself under the necessity of increasing his steam delivery 50 to 100 per cent or more without warning. Under such circumstances he must put more coal through the stoker even though by doing so, he may lose a considerable amount of unburned carbon. As has just said, the power dump is probably the



Cross section of mechanical stoker equipped with power dump for ashes. The arrows show the direction of air circulation

most effective method of cleaning fires to accomplish this purpose. It provides a variable rate of ash discharge that functions at the will of the operator. It requires the minimum amount of time to drop the discharge plate, so that the accumulation thereon may fall into the ash pit, and return the plate to its normal running position. A glance at the accompanying drawing

will show why it is easily possible to perform this operation in less than half a minute. It is especially noteworthy that in such operation with the power drop, there is practically no interruption to steaming as the result of the cleaning period.

Ventilating an Existing Tunnel

SO great has been the increase in motor vehicle traffic in American cities that those which have street tunnels are finding in many instances that a new and serious problem has been created. The exhaust fumes from motor cars are not infrequently the occasion of much annoyance in busy city streets and even cause serious discomfort when wind and weather conditions are such as to cause the fumes to accumulate. But far more serious is the accumulation of motor fumes in traffic tunnels. These boro were originally constructed when automobiles were few or wholly unknown. With the advent of the gasoline engine and the resulting increase in the number of vehicles on the streets many tunnels have become traps for fumes which in some cases have actually endangered the lives of persons passing through these boro.

So serious has the problem become in Los Angeles that it has been necessary to sink two perpendicular ventilating shafts from the top of the hill through which the city's most used tunnel passes, so that by means of electric fans the foul air in the underground passageway can be drawn off. By this means the air is changed entirely every few minutes. One of these shafts is 42 inches in diameter and the other one approximately 18 inches.

The problem of how to dig or drill these ventilating shafts proved an unusual one when the city engineers started out to find a concern that would undertake the contract. The task was different from the ordinary run of drilling or digging jobs and the authorities were somewhat at loss to find men competent to undertake the work. The most practical way seemed to be to drill the hole from the top of the hill to the roof of the tunnel with some kind of well-drilling apparatus, sinking the bore as large as possible. Accordingly a driller of oil wells was hired who drilled the smaller of the two holes already mentioned at what was conceded a reasonable figure. Before he had finished his task, however, the work attracted the attention of a man who owned and operated a machine digging machine. His equipment was entirely different in character and by means of a rotary digger he was able to sink a 42-inch shaft at no greater labor than that with which the driller could sink an 18-inch shaft. Accordingly, the contract for the second vent was transferred to the machine digger, who has completed half of the task at a figure a little lower than that charged by the well driller. Under all the circumstances and in view of the unusual character of the undertaking the city felt that both men had earned their money.

The improvement in the way of two vents with electrically operated fans has proven highly satisfactory and the much used Los Angeles tunnel, which is nearly a fifth of a mile in length, is now filled at all times with clean, wholesome air. Formerly when there was little wind and traffic was heavy the tunnel was so full of fumes that pedestrians found it almost impossible to make their way from end to end.

The Use of Paper in Gardening

WHILE the use of paper for many useful purposes in gardening, growing flowers and vegetables, may not be new, nevertheless the advantages, which may be gained by such practice, are not generally known.

Most people know that paper is a good heat insulator, that is, it is a very poor conductor of heat. Hence, when an object is enveloped in paper its inherent heat is prevented from being rapidly dissipated and at the same time the cold or hot air, surrounding the object, is prevented from coming in contact with it and either detracting from or enhancing the heat contained in the body.

It is this property of paper that makes it so useful in gardening. Furthermore, while ordinary paper is non-transparent and non-transparent when the paper is asked, it will allow light to pass through it, and at the same time it will be effectively waterproof. This fact is also of importance in rendering paper applicable for many purposes about the garden and the greenhouse.

Actual practical experience has shown that it is possible to obtain effective protection for young seedlings and tender plants against the inclement weather of winter and early spring by the use of paper. In-

houses during the cold winter months. When the seedlings first send up their shoots above the ground, it is often necessary to shade them from direct sunlight. In this connection it has been found that the diffused light which penetrates through oiled paper is particularly well suited to them, and the shade structure must be erected when glass frames are used, are unnecessary in this case.

Old newspapers have been put to many purposes. They sometimes serve to protect the person against cold in lieu of an overcoat. The same property, which renders them useful for this utilitarian purpose, makes them a very effective protection against cold for tender plants. In the early spring, when frost may still appear on the ground over night, it is wise to cover the plants with newspapers as the evening sets in and does not remove them again until all the frost has disappeared the next morning. If this is done regularly and conscientiously, no fire heat at all is required, thus simplifying matters and saving money.

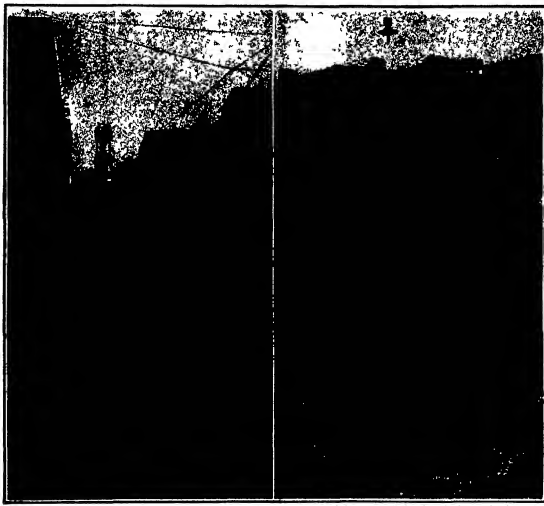
It may be imagined that when newspapers are used as protection against frost, it sometimes happens that one forgets to use them a certain day and the next morning the plants are frozen. Here a moment's thought must then be taken to bring them to life again. The best thing to do is to spray them with ice cold water before the man is up and to protect them against the sun's rays with paper covering for some time thereafter. The remedy is drastic but sound.

An instance is cited of a large lot house full of clematis which were completely frozen over a certain frosty night. In the morning the apparatus going out of order. The plants were quite black and apparently ruined, but were brought back alive without any ill effects by means of the above treatment.

"Only a Little Trick—Let It Run"

THOSE best qualified to express an interest in waste of water are those who have the bills to pay. It is in communities where water is not so metered that waste is most apt to be ignored, but in the long run the water pays the bill. To enable the average person to visualize the amount of waste that can result from a leaking city street running, a Madison, Ill., maker of water works equipment has issued a pocket piece resembling a twenty dollar gold piece. This will insure its attention at the start. Of three tiny holes which are bored through it, the largest is only one-eighth of an inch in diameter. The pocket piece bears the legend that in a day of 24 hours, 3000 gallons of water would be wasted from an opening of this size. Another hole which is a moderate size, the insertion of a pencil lead is stated to be the potential waste of 1000 gallons a day, while a third hole, just large enough to receive a pin, is a considerable leakage enough to permit the flow of 180 gallons or over 3½ barrels. This corresponds to about 140 cubic feet per year.

The figures given are for a head of 40 pounds. Higher pressures would increase the waste, though not in direct proportion to their value. The best remedy is a tiny leak, remember that it is capable of making a larger dent in the purse than apparatus would indicate, and do not be surprised if a rigid inspection of plumbing is carried out at times when a water famine is a possibility.



Left: Street view showing end of the Third Street tunnel, Los Angeles. One of the new ventilating shafts is clear to the observation tower. Right: Sinking the 42-inch ventilating shaft, 90 feet deep, with the use of a manhole digger. Los Angeles' street tunnel, designed in modern days, has had to have ventilating shafts added to take care of the exhaust gases from automotive traffic.

stead of employing expensive glass for the windows of frames and greenhouses, oiled paper may be used with just as good results and in fact, if taken care of as conscientiously as glass, they will last just as long. Of course, the cost is very much less. It must be mentioned that such oiled paper lights may be exposed to the weather as much as possible and will possess long life. Another saving is in the construction of the frames, which need not be nearly as heavy as when glass is used.

The use of paper for this purpose is not in any way universal, but it is due simply to ignorance of the effectiveness and the cheapness of the material. In France, where intensive cultivation of vegetables is carried out to a far greater degree than in this country, the value of paper for making the windows in hot house frames has been appreciated for some time past and paper is largely used for this purpose in that country. Very good results have been obtained in the use of oiled paper for covering pits in which there were stored surplus chrysanthemums, tender shrubs and similar plants that must be protected in green-

More Water for Washington

The Great New Conduit that Will Double the Capital City's Supply

By George H. Dacy



THOUGH that Washingtonians may have had to wait a long time to drink the City of Presidents has been menaced by a poisoning water famine for several years—since 1901 is building a large new water conduit that extends from Great Falls and the boundary of the District of Columbia where a new metal filter plant will be installed. Away back in 1848 the first conduit is circular brick tube nine feet in diameter, and nine miles long was constructed to carry the water supply of our half metropolis from Great Falls to the Washington consumers. This small water channel or tunnel was the first of the great engineering feats of that day and age. Subsequently, in 1888, a permanent road was built directly above the tunnel in the line of the conduit. For many years it was the only water supply until about a decade ago, when in most beautiful American city began to grow and attain the dimensions of a world wide capital. The population increased very markedly. With the advent of thousands of new thrives came the water supply began to be inadequate. Now with a population of more than 400,000 persons the residents with an old thousands of transients thriving, the Federal capital needs the 24-hour water supply of 100,000,000 gallons is insufficient. And peculiarly enough the consumers use more water during the winter than during the driest hot and sunny months of summer probably due to the fact that many of their water run constantly to keep the pipes from freezing in cold air, such as in our Capital City that military drills, water has to be used in washing the streets, sprinkling, lawns and extinguishing fires.

A new concrete conduit is now under construction which is built in the route of the old conduit. No more is the evidence of the revolution that has been worked in engineering and construction operations is to be found than to extract the systems of building employed in installing the old conduit and its new replacement. Admittedly the work of more than a half century ago was excellent. It has withstood the onslaughts of time and will serve its purpose. A product of an era of cheap hand labor the old conduit has been efficient and durable at least in engineering however is a flag now in view that it took many months and even years to construct during the period prior to the War of Secession.

The concrete pipeline now under construction is 30 feet high and 10 feet wide—big as horse-drawn. Whereas the conduit now in use has a cross section of about 80 square feet the new concrete is approximately one-quarter larger. When completed the twin pipelines will have a combined carrying capacity that will practically double the water supply of the water supply. There will be the additional benefit



The mechanical traveler that moves the forms from section to section after the concrete has hardened. A temporary track leads the conduit order submitters such that support the interior metal forms. These forms are then moved with the work pulled by rope cables. A groove in the end of a section, to make the sections joint.

Some details of the work on Washington's new water-supply conduit.

feature that potentially if either of the conduits need repair such one can be temporarily put out of commission without putting the District of Columbia on short ration.

The concrete conduit is being laid in 80-foot sections, the facilities being such that one of these sections of concrete can be prepared daily. Extraordinary metal forms are used which take the dirt and danger out of concrete work and which immeasurably expedite the work. The excavation is accomplished by the use of power-driven steam shovel—mechanical diggers that have eliminated the arduous hand toil from trench work. After the trench is properly prepared the concrete base of the conduit is laid in place—the foundation is 10 inches thick, the wall of the conduit pipe being smallest at the base point. The walls are 84 inches thick at their base point and 12 inches thick at crown of the arch in the neighborhood of 100,000 cubic yards of concrete will be used in the building of the nine-mile conduit the mixture being a mix, two, four combination. Two lines of temporary steel trackways are installed when this concrete foundation is not thoroughly.

The inner tracks provide transportation facilities for a series of small cars that are equipped with turnbuckles

and powerful jacks that govern the raising and extending or lowering and collapsing of the interior metal forms that hold the concrete in place. Briefly these metallic forms, which strikingly simplify concrete construction of this character, can be moved about on the midge cars that run on the inner trackway. When the time comes to move the interior forms they are lowered by means of the jacks and loosened by use of the turnbuckles. Cables are adjusted properly and hitched to a gasoline tractor that runs along the roadway above the trench, and sets a steel frame to haul the steel forms to the next position of setup.

The other pair of steel tracks extends along either side of the conduit and provides passageway for the exterior forms which are hung on a special traveler that will convey them to the next point of construction. Turnbuckles and hoisting devices are used to raise and widen the exterior metal forms after the concrete has been poured and set sufficiently for such operations. Altogether, the national engineers are using three sets of these mammoth metal forms which cover a stretch of 140 feet. They pour the concrete in the last form of the train first so that by the time they are placing the concrete in the third form the first one can be moved to a position 240 feet farther down the trench. This arrangement eliminates any confusion in the work in order to wait for the concrete to set. The exterior forms are moved to new positions in the same way as the interior ones by hitching them to the tractor and hauling them to the new sections of construction. After the concrete of the conduit has hardened sufficiently a steam shovel is used to fill in around the huge underground waterway. The trench is partly filled with water as the earth is dumped into place so that it puddles and compacts as desired without any additional man labor.

In course of 465,000 cubic yards of earth will have to be excavated before the concrete conduit is completed about June 30, 1914. The cost of the subterranean tube will be more than \$2,000,000. In the rocky region fringing the Chesapeake and Ohio Canal and the Potomac River great difficulty has been experienced in cutting the ditch for the pipeline. Over an stretch of two miles, the cut has been made through solid rock and has ranged from 10 to 40 feet in depth. At Cabin John, Md., where a tunnel was what was formerly the largest masonry arch in the world but which is now surpassed by a bell later in Germany, a huge concrete-and-steel abutment will be installed to carry the water through a gap that is 200 feet wide and 140 feet deep. The abutment will consist of a circular steel pipe 10 feet in diameter, which will carry an interior cast of concrete at least 12 inches thick, as well as an outside overcoat of the same material that will be 12 inches thick. Two tunnels will also be cut at so many fifty feet apart, for inspection and possible repairs.

Protecting a Beach From Erosion by Ice
 The ice which has been so much a menace to the beach at this place of construction which the writer did with his own hands unaided in ten days' time. The job consisted in the construction of a concrete sea wall to protect the beach in front of his home in Northern Michigan from the ravages of the yearly spring ice flows.

The wall was of trapezoidal section, 8 feet 6 inches thick at the bottom, 12 inches thick at the top and 8 feet 6 inches high. The lower 16 inches of height was under water. The essential points wherein labor was saved lay in:

1. The use of a single section of non-collapse form, which was set and filled one day, and moved ahead and filled again the following day. This form was weighted in place by two rocks not being sailed, so that no wrecking and rebuilding was necessary. The rocks were simply removed the form lifted slightly to loosen it and pulled ahead by hand into its new position.

2. No gravel was mixed with the mortar. Dry stones graded in size from that of a hen's egg to that of a man's head were placed in the form. A very liquid mortar of sand, cement, and sufficient lime to insure fluidity, was then mixed with a hoe in a mortar box and dumped into the stones, where it flowed down filled all the interstices and bound the whole together into a solid mass. Thus about 90 per cent of mixing labor was saved, besides making it possible to substitute the relatively easy hoe mixing for shovel mixing.

3. Sand dug out of the trench for the wall was thrown directly into the mortar box, ready for mixing, without any further handling.

4. The mortar box was supported directly over the wall, so that by simply removing a movable end, the mortar ran by gravity into the form.

The wall was poured in sections and only half of the height poured at one time, the upper half of one section being poured at the same time with the lower half of the following section. Thus 7 feet 6 inches of wall was completed each working day.

In the morning a row of light sheet piling was driven in front of a section of wall to keep the waves from dashing into the work. The sand was then excavated to a depth of about 18 inches below water lines, and a layer of old plank laid on the bottom and weighted down with rocks. The form for the lower part of the wall was then moved ahead placed on the plank floor and weighted into place. The form for the upper section of wall was moved ahead on to the lower section and poured the preceding day.

In the afternoon, both forms were filled with rocks placed by hand, and the great sufficient to fill the voids between the rocks was added and poured. Usually two batches would do this. There was usually a little time remaining in the afternoon, which was given to finishing the surface and painting with a waterproof cement paint.

The wall was also tied together longitudinally by several second hand light weight railroad rails which

were purchased from the owners of an abandoned beach, and which were placed by hand in the forms before leaving the rocks around them. Four of these were bedded in the wall for its full length. The space behind the wall was afterward filled solid with sand and boulders hauled in by a local farmer.

The prevailing wind is diagonal toward the beach and there is a continual drift of sand along the beach by reason of the diagonal motion of the waves. After building the wall the writer conceived the idea of placing obstructions in the way of this sand drift to hold it and build a beach outside the wall making things additionally secure. He drove a few lines of sheet piling just outside the wall and transverse, to projecting a few inches above water. The result was that in a couple of weeks a strip of beach from six to eight feet wide was made outside the wall. The first season's use has shown this to be a thoroughly satisfactory protection. The slugs, front free of the wall deflecting the sea wave and breaking it up as it beats the shore.



This blast was produced with charcoal, impregnated with liquid oxygen

Liquid Oxygen as an Explosive

LIQUID oxygen is produced commercially by the fractional distillation of liquid air. The latter substance has the ordinary atmospheric air, contains 21 per cent of oxygen and 79 per cent of nitrogen. The nitrogen is more volatile and evaporates more rapidly than the oxygen. Taking advantage of this, apparatus

has been designed for evaporating all the nitrogen out and leaving the liquid oxygen. This is a liquid that condenses free oxygen because it avoids the expense of getting the free oxygen in the gaseous state, free from impurities.

Among the interesting possible applications of liquid oxygen one is as an explosive in connection with charcoal. Wood charcoal at zero Centigrade will absorb 18 times its volume of gaseous oxygen, at the temperature of liquid oxygen it will take up 230 volumes instead of this more 18. The charcoal thus impregnated burns with such extreme speed as to give violent detonation.

The explosion pictured was produced by liquid-oxygen impregnated charcoal, using house made methods exclusively. The charcoal was finely powdered and raised in a liter sack $\frac{1}{4}$ inch in diameter and 15 inches long to the end of which was fastened a dynamite fuse. The charcoal was then placed in a prepared

up under a 14-inch stump and after smothering the end of charcoal in liquid oxygen for about two minutes it was exploded in the tank of the house light. The explosion was similar to that of dynamite. The stump was entirely removed and the roots so shattered that it would be little additional work to remove them while it seemed that after using dynamite the stumps are often merely split without removing them.

It is suggested that liquid oxygen can be made at a price to compete with other commercial explosives. Other substances such as cork, salt sawdust, etc. may be used in place of charcoal.

Weathering Tests of Stone

WEATHERING tests consisting of freezing and thawing of the specimens until deterioration occurs are in progress at the Bureau of Standards on 23 samples of limestone and 23 of sandstone. Some of the best limestones have withstood 800 frostings with but showing any appreciable amount of decay while the poorer grades of this material were disintegrated by 100 frostings. Tests on the sandstones have only recently been started, and so far the samples have shown no great amount of decay.

A number of limestone and sandstone specimens are also being tested by soaking in 15 per cent solution of sodium chloride and drying afterwards to obtain a crystallization of the salt in the pores of the stone. This produces an action similar to that of frost but more severe. It has been found that limestones which stood up under several hundred of the freezings were disintegrated by less than 100 crystallizations in the salt test. However the actual disintegration seems to be similar to that produced in the action of frost and hence it is believed that there is a possibility of using this method as an accelerated weathering test.



The owner of this bungalow has temporarily choked the spring flow of ice in the lake, which threatened to sever his property off the map

Laying Rails 420 Feet Long

WHILE engaged in relaying track the street railway line in Washington, D. C., recently adopted an unusual method of welding and installing its rails without interruption to traffic. The rails to be installed were laid along the side of the street parallel to the track, welded together during the day time by means of thermit welding into continuous lengths of several rails, then transported with the aid of a large gang of men equipped with rail tongs close to the edge of the track and installed during the early inactive hours of the morning.

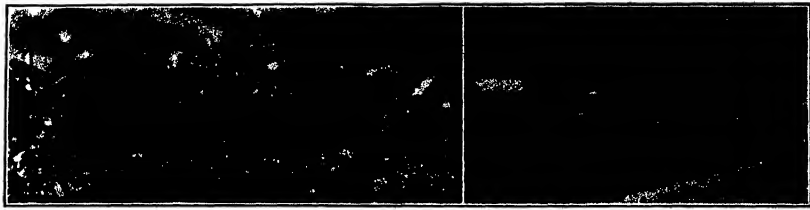
In one case a pair of rail lengths each consisting of seven rails, making continuous lengths of 420 feet as shown in an illustration.

Aluminum Scaffolding

WORK has become very expensive in Germany so that at the Chemnitz Opera House aluminum has been substituted for wood for the frame for scenery. Scenery thus mounted is much easier to handle and the fire risk is minimized. The scenery can be attached to both sides and even decorations can be painted on the wooden frames. No electric difficulties have been experienced.



Welding rails before laying, and placing them in 420-foot lengths after traffic has ceased for the day



Left: Army ants marching in single file, note the great grubs marching on the central figure (magnified three times). Right: Army ant bringing home as booty the leg of an insect victim. This

Scene from the Guiana jungle, when the ants are marching

The Army Ants of British Guiana

Jungle Insects that Have Learned the Importance of Force of Numbers and Discipline

By Paul Gruswold Howes

Assistant Curator of the Bruce Memorial Museum, Greenwich, Conn.

UPON the very moist floor of the great diu-jungle that covers nearly all of British Guiana, live the army tribes of army ants. These tribes consist of astounding numbers of individuals, divided into various sizes, and upon whom fall various burdens in the general economy of the groups. They move as permanent nests at all, but hasten from the forests, carrying the entire where-with-all of their arduous existence along with them.

The first army that the author ever witnessed on the move, was travelling rapidly across an open space in front of the camp. The flow of march was not over five inches in width, but it extended across the clearing for a hundred and fifty feet in a steady band, and continued out of sight into the growth of vegetation beyond. This army moved for many hours without halt, or even the slightest let up, and there must have been hundreds and hundreds of thousands of individuals in the line. Their destination was an old foundation on the edge of the clearing, and into this the insects poured all day long. The ants carried everything that belonged to them as they moved. Nests could be seen by hundreds, bearing the white grub-like larvae or young ants, while countless others carried eggs and pupae, or ants about ready to take their work in the tribe. Soldiers with enormous curved jaws lurked along with the rest, snapping viciously at anything that attempted to interfere with the general progress of the lines. Where an obstacle hindered the march, dozens of the medium sized ants would make a living filter of their bodies, over which the rest would pass in greater ease and comfort. By night the nurse ants and all the rest were asleep in the foundation that they had picked for their transient visit. The ants could be seen forming a dense network of their bodies, among which the eggs and young were being kept safe and warm, while all about the it camps, others rushed here and there, scouting and piloting the grounds in a general clean up of the surroundings.

The ants stayed here all night but by morning they had gone into the forest. This army was simply moving. The command of march had been given and march only. No hunting was to take place and so the whole great tribe moved forward in a thin line without a glance from side to side. Such is the nervous discipline of insects.

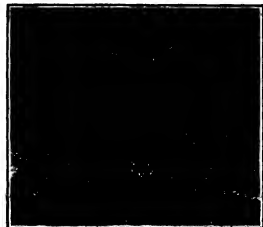
When the command runs hunt, everything changes. The militar attitude of the multitude changes instantly. Every ant becomes a ferocious demon, a very reckless and unscrupulous creature that will attack anything and give its life for the moment's action. Then again it turns itself into the forest in great networks, that gradually enclose certain areas, and every living thing that is weak as well as many of the stronger ones, fall before the onslaught.

If one is traveling through the forest, a certain sign of presence of a hunting army, is the chilling and chilling of a number of different ant-thrasher, and other birds that have been driven from the trees. These birds follow the armies, partly because of the insect life that is stirred into panic, and partly because of the

thrifts of refuse that the army leaves, in the form of eggs and other parts that have been torn from the victims.

When such a flock is heard, a few minutes' hunt will reveal the army at its deadly work, while at other times one will know well enough that the lines have been crossed by the severe and thorough biting of one's legs, followed by a painful stinging that causes one to take to the trail in haste to remove the envenomed insects. Once they bite into the skin their jaws become quite tightly locked so that it is often necessary to pull them apart, and the Indians use them for closing wounds by causing them to bite, after which they sever the heads from the bodies.

During these drives, every insect is frightened from cover and instantly pounced upon by as many individuals as happen to be near. They actually tear the victim from limb and it is then taken to the nest for that day, in many fragments. Almost as soon as an ant line secured a portion of food, it ceases its wild



Front view, greatly enlarged, of a warrior ant, showing the powerful nipper

blood thirsty actions and goes to the rear, its duty accomplished.

If a large insect such as a grasshopper or a big jungle roach is thrown among the ants, it will event-ually be vanquished by sheer weight of numbers. As it lands among the warriors, one or two will lock their jaws upon its legs with lightning rapidity. The sufferer will now hop or fly in agony, but the instant it lands again, several more ants will grab its appendages. This procedure soon weakens the victim to the ground permanently, where it is torn to shreds without delay.

Ants returning to the rear often assist one another in various ways. As it is usually the custom to straddle the body on the homeward journey, the ant is frequently greatly hampered by the size of the cut. Again a long caterpillar may be the victim, one that has been

left intact, owing to its slight resistance, and thus becomes a great burden. In these, and similar cases, ants were observed to come to the assistance of their sisters. They would help drag the insect along or hold the abdomen of a sister up out of the way, and in case one two ants were seen to straddle a caterpillar and thus carry it along on their tall legs, like so many laborers carrying a railroad rail or a big log.

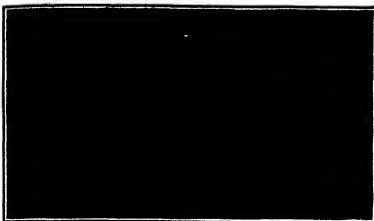
Birds and animals are not immune to the attacking ants, especially young ones. In fact any animal would soon succumb to their myriad bites if there were no avenue for escape. One realizes how great are their numbers when a distant and strange rattling murmur reaches the ear, due to the thrashing about of countless bodies.

None creatures have learned to escape. Thus the smaller species of spiders, leap from their perches at the approach of the ants and remain safely suspended upon a silken thread until the danger is past. On the other hand very large snakes are sometimes killed and devoured, before they can get beyond the lines of the army.

The entire tribe does not take part in the drive for food. A large number of workers remain at the tent (nearly) nest to care for the eggs and young while the warriors are away, and swarms of workers are cluster the entrance so that it looks like a brown very vegetable growth, from a short distance. As the hardened hunters return, they are carefully brushed and combed by the workers, and their body is dropped and carried into the nest by these individuals also. The actual passage to the interior is lined thickly with a network of ants so that every individual must pass along a living passage to pin entrance.

The Indians of Guiana like those of many other South American countries and also the Bolivians and white people, have learned to respect the army ants because of their house cleaning propensities. Every house, from the rude thatched huts of the Indian to the solid wooden ones of civilization, are more or less infested with very large roaches, and other insects, and also huge tarantulas, which come only to obtain the roaches. None of these things are liked by the average human being, but the army ants are fond of all of them. They come not infrequently, in tremendous armies, to the chores of man, and in the course of a few hours leave them cleaner than they have ever been before.

In these great tribes there is but a single Queen. Her sole duty is engendering after the colony is once started and she is given the most exquisite care all during her life. She is sheltered and watched and attended like a pet Queen and no harm can easily come to her. Periodically, a brood of young Queens and males are hatched. These individuals are winged and as soon as they are mature, all of them leave the tribe what is known as the marriage flight. Then Queens finds a mate, They pair and the males soon die afterward, but each young Queen finds her own new tribe and after bringing it to marriage flight. Thus a little crowd set not to rear about themselves another great giddy band of army ants.



An effective barrier to keep cattle off the tracks is provided by this uneven assembly of rollers

Scaring the Cattle Off the Tracks

MUCH interest is attached to the recent development of a control roller cattle guard that it is believed will prove effective in preventing stock from passing. There are four sections, one of which is placed outside each rail and two between the two rails. Each section is composed of several wooden rollers three inches in diameter at one end, four inches in diameter at the other and twenty-four inches long. Four steel side end plates bolted together constitute the frame, by means of which the guard is subbed to the tie. The rollers are supported on metal rods on which they rotate.

As animals approach the guard they are alarmed by the irregular and strange appearance presented by the alternating metal rollers and must not come any nearer. But if they become bolder and advance up to the guard so as to place one foot upon it, the rollers revolve underneath their feet, and most animals will immediately leave. Where the animal puts one foot upon the rollers and, still unalarmed, tries to advance with another foot, his weight rotates the rollers under his foot and he will find it impossible to proceed.

A Clever Job of Continuous Packing

AN interesting apparatus for the mechanical packing of tin is to be seen in a San Francisco factory. An overhead track system supports a unit of six traveling bins, which can be shifted so as to bring any bin directly above the chute, *B*, that leads to the weighing scales. In this way any number of runs can be packed with any desired type of tin, and a shift made as often as the orders of the day require, or special blends can be made with a minimum of trouble. The overhead system is operated by a drum-wound cable, and any bin can

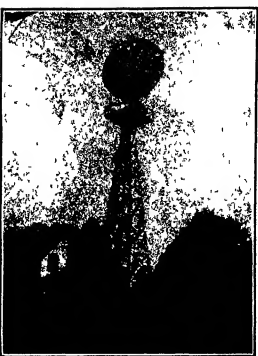
be brought into the dumping position in a few seconds. The bins themselves are kept supplied with tin from larger storage on the floor above, to which they are open. There are six bins, and only five brands of tin to be packed so that at all times a bin is "left over," and can be filled from above while one of the other bins is being the last of its own tin into the packing machine. In this way tin can be kept running continually, with never a failure of the supply of any brand and never an empty bin. We have seen numerous applications of the idea of even tinness packing, but none that seemed more generally effective than this one.

The Wind-Power Automobile

A automobile whose operating system includes no provision for power might seem as though it would go in the class with the mysterious green fluid that makes gasoline out of water—it certainly sounds like a crazy dream or an outright fraud. Nevertheless Mr. A. J. Root, the dean of the American law industry and publisher of *Chatterbox* in *Brooklyn*, has such an automobile at his winter house in Florida.

The answer is a pair of busy windmills. The car is an electric. The mill is two in number, 16-foot wheels on 60-foot towers. Instead of having a counter-shaft or a set of gears to multiply the speed of the wheel to the necessary dynamo speed, the dynamo is mounted on the platform immediately beneath the wheel and connected by means of a belt running over around the circumference of the wheel and then directly to the generator shaft. To provide for varying weather conditions an belt is used to take up the slack of the belt. The belt itself is made of a specially designed fabric which serves with complete success all the weather conditions to which it is exposed. Whether it would fill the bill in a more rigorous climate is not stated, but the mill is manufactured in North Dakota and is also used there for farm lighting, which suggests that blizzards are a more incident in its life. The generator is mounted on a revolving platform and goes with the wheel as the wind shifts. The cost of a single unit with switchboard and all other apparatus but without a battery, was given, at the time of writing, at \$1500. We think it probable that today it would be somewhat less, but whether the reduction would be a material one we cannot say with any degree of certainty.

It is a familiar experience with news of the gasoline automobile that it is not an economical means of providing small units of transportation. Many cars are employed for little more than the shift drive to the station and back, a run of or at the most five to six miles. Cars that develop 20 or even 25 miles per gallon on the highway are heavily taxed to their work at the end of the run to the station, and give this sort of service at excessive fuel cost. The electric is an ideal vehicle for work of this character, if the work of charging can be done without paying an excessive price to someone. For charging from a windmill, as light a



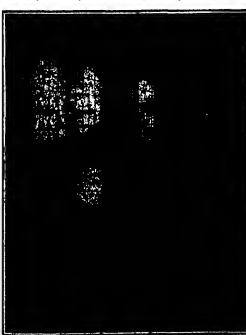
This windmill and another like it drive the family car about six miles per day, and light the house in addition

turning over at a predetermined rate. Contrary to what the non-electrician might expect, such cut-outs are neither complicated, nor likely to get out of order.

Mr. Root, from his two windmills, keeps his car fully charged for its regular run of five or six miles per day, and in addition lights his house. He finds that a single windmill operates rather fitfully, but that with two poles at once, even when they stand close together, the wind is sufficiently capricious to insure that one will usually be running at charging speed even if the other is not. Aviators will confirm the inference that considerable variations in air current are met between points only a couple of hundred feet apart. With his two mills connected up, Mr. Root finds that the charging curve is entirely smooth enough for all purposes.

A Lilliputian Piano

AMONG the attractions of one of London's summer places is the miniature grand piano illustrated. Exact dimensions are not given us, but the finger of the user affords a very good approximate scale by which the actual size of this tiny musical instrument may be estimated. In spite of its *Ten Thumb* appearance, this piano can be played in the usual way by one with sufficient control of his fingers. The extent to which the editorial digits mind the wrong key on the editorial typewriter make us wonder what kind of a finger this would be, but that does not alter the fact that the piano can be played, just like any other piano by anyone able to play it. Perhaps, in the case of some of the string instruments, one picks at this key board with an artificial finger-end.



Movable bins on an overhead track add flexibility to this tin-packing outfit

machine as possible should be secured, with a small battery that does not need much if any more than 25 miles on one charge. A light battery, charged little and often and kept full, is the thing for this usage. The automobile is to be left in the garage and connected with the dynamo all the time when it is not actually on the road. A cutout, similar to the one between battery and generator on the ordinary gasoline cars, must be provided in order to insure that at low speeds or when there is no wind at all the battery shall not be charged through the dynamo. This cutout is operated magnetically, and breaks the circuit leading to the battery whenever the dynamo is not



Speaking of baby gramps—here is one from a London amusement hall

What Happens When the Tire Hits the Road

Studying the Impacts from Pot-Holes and Obstructions, with Different Types of Tires

WHILE destroying America's highways? The road engineers, the truck driver, Jack Frost the politician, the speed demon and the road builder have all been accused. Each pleads not guilty and the courts go right on deciding. Now the United States Bureau of Roads is attacking the question with every prospect of getting an answer. The investigation deals with road surface, road structure, sub-surface drainage, and traffic. Of permanent value are the findings under the first three heads, but of paramount interest at the moment are the results of the examination into the traffic, and what it does to the road.

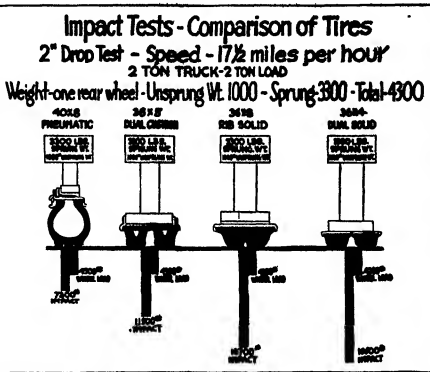
Most significant of the findings is that it is not chiefly the dead weight of motor trucks that destroys the highway. If a truck arrives at an obstruction on the road, or if it runs into and out of a pot hole, the wheel comes down on the road with a fluid. It is this impact that does destruction, crushing the surface and breaking the foundation.

This impact can be measured as a function of truck weight, of truck speed of load per unit of wheel bearing surface, of road design. Tons of clouds and freight snaking along the highway create the same blows upon the pavement, this is not to be avoided. But the force of these blows can be reduced.

The chart herewith shows some of the results of the study of the problem. A solid tire, fifteen-truck, operating at 17½ miles per hour with a five-ton load, on striking a two-inch obstacle delivers a blow on the pavement of 25,000 pounds. The same truck, with pneumatic tires, may carry an extra ton of load and under the same circumstances deliver a blow of only 11,500 pounds.

Does this indicate that all trucks ought to be shed with air? By no means. Impact varies with the speed and the load carried. Take the coal dealer delivering in a business district. The extreme weight of the truck and the load restrict the speed to very moderate figures, and the heavy traffic has the same effect. Conservatively little consideration is necessary to protect the road and the truck from the harm of impact at these low speeds, so a solid cushion tire, with its greater bearing surface, is advisable to distribute the dead weight of the load over more of the pavement. As the load goes down and the speed goes up, the demand for cushioning gains in importance and that for dirt buttens less. Then we may replace one or both pairs of solid tires by the cushion type, combine the cushion with the pneumatic, or, finally, mount four pneumatics. But on all trucks up to a limit of 2½ to 3½ tons, where a wide range of operations is an important factor the big, flat, new riding pneumatics are highly desirable.

There is a right and proper and economic tire for each set of conditions. Knowing the condition—the road, the load, the service to be rendered by the truck—one may follow the diagrams of the Federal engineers and diagnose with a high degree of accuracy the type of tire needed. Particularly suggestive is the finding with reference to the impact from a six-wheel, conventional, with six wheels, the load per wheel is less and the impact per wheel less but one would not



The blow delivered to the road when a two-ton truck, with a two-ton load, runs into a two-inch hole or rut, depends very largely upon the type of tire carried. At lower speeds the difference would be less, at higher speeds more, in favor of the more shock-absorbing tires.

necessarily be prepared for such a difference as the chart shows. To the layman, in this connection, it may be necessary to point out that six impacts of 7000 pounds each, even if they all come in the same place, will not do the damage that will accrue from four blows, of 11,000 pounds or a bit less each. Conceivably, the road might stand up indefinitely under the lighter blows, and disintegrate rapidly under the heavier ones. Hence a lightening of the blows, by greater cushioning, or by malification of wheels, or by any other means, works out into a saving of road repair costs quite dis-

proportionate to the cost of the better trucking practices.

Considering the three types of tires, it seems easily susceptible of proof that the pneumatic has greater cushioning, can be operated over an open stretch of road in a shorter time, and does less damage to road and vehicle, than either of the others. There is a point where the possibilities of time saving, and the need for cushioning, become so small that it is no longer economical to use the pneumatic. In short-hauling freight will probably continue to be carried on other types of tires. But the practice of short-hauling truck-owners, of economizing on tires at the public expense as measured in road destruction, cannot go on indefinitely. The graphs of the Federal engineers give ample basis of proof for taking any necessary steps to insure that trucks be properly shod for the loads that they carry and the speeds that they attain.

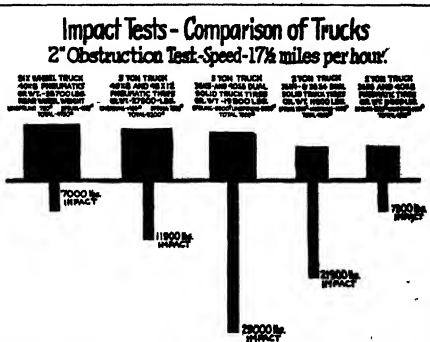
The Stomach of Insects

IN the last report of the Smithsonian Institution (1922) Dr. N. H. McIndoo has an interesting article on the stomach of insects. After discussing the anatomy of insect vision, both by simple and by compound eyes, the author proceeds to the stomach of insects, which is first as a means of recognition. This means is far more developed in insects than in other animals. The stomach of a bee is so constructed that it is probable that each individual bee has its peculiar odor, but it is the combination of all these that makes up the hive odor and this is regarded as the most important and as indeed the ruling power in a colony. It is a means of protecting the social life of the bees from without, and the queen odor which is a part of it insures continuation of the social life within. The workers "know" their hivesmates by the odor they carry. This insures harmony and a united defense against attack.

The queen odor constantly informs the workers that their queen is present. Even though she does not rule, her presence means everything to the bees in perpetuating the colony. The odor is the actual or the hive odor and queen odor, and being guided by instinct, the bees know their queen's odor is a better ruler. Among ants the same broad principles hold, but here the faculty of smell is the most important.

What, then, are the organs by which insects recognize these odors? Dr. McIndoo has identified them as small pores scattered or grouped on the body and appendages. A nerve ends in each pore, and the organ is often protected by a hair. By covering the pores, experimental proof of their olfactory function was obtained.

That, too, among other insects, one discrimination between foods is well known, and that their power of discrimination seems to be of man was experimentally proved by Dr. McIndoo. He describes this vision as follows: "The sense of smell. There and smell are closely allied, and it is possible that the sense of smell is the sense of taste. The organ that receives the stimuli themselves being identical, it is possible that the sense of smell and taste are connected by the olfactory tract, so that the discrimination is probably made by smell."



The United States Bureau of Roads, in addition to the "bump-off" impacts of our first driving, has also studied the impact of a truck on a obstruction. The difference here is even greater in favor of the more efficient tire than it was in the drop test.



Mail dropped in this box in the country is collected in the city, to the great expedient of its handling

A Traveling Post-Box

RURAL free delivery is not the only means of extending the scope of Uncle Sam's service to communities isolated from the main line of communication. The latest idea for making the mails more useful involves the mounting on interurban trolleys of ordinary mail boxes. At any point along the line letters may be posted in those boxes to be removed by the postman when the car reaches a good sized town. This is a long step forward from the condition where the people strung out through the country are dependent upon the once-daily passing of the mail carrier for their contacts with the outer world.

Motor Propulsion for the Legions

HIMSELF a cripple through an attack of infantile paralysis, a member of one of New York's oldest families has invented the legless automobile which we illustrate. Though the car is seen with trusses and shoes his legs are useless to him, and any means of navigation which he employs must be one that can be entirely controlled with the hands. The conventional wheel chair did not appeal to this particular man, and he deplayed a touch of inventive genius in designing a motor-driven substitute. It is in fact a very droll worthy of the designation "automobile" save only that its dimensions are a bit nearer those of the motor cycle. It is but 32 inches wide and 70 long. It also strikes nearer the cycle than the car in that it has a single front wheel, steered by her rather than by wheel. The other controls are for the larger part assembled upon the handle of the bars where they are easily accessible.

Airplane, or Plain Flyover?

WHILE M. Barbot and his aerial flyer are in the public eye seems a good time to put on display another kind of airplane flyer—the actually built upon the foundation of a Tin Lizzie chassis. As the picture makes clear this plane is designed for the advertising purposes and not for flying, and it does all its running with four wheels on turners. Nevertheless its body is built on exactly the lines of a regular airplane, even being equipped with rudder and elevator. The rider gets a practical touch by serving as a direct ion indicator to the driver behind and for this end it is connected by cables with the steering gear. The car is equipped with port and starboard lights and the propeller can even be driven around by the engine.



This airplane-style body is the latest model in Easy Flyers

Gas and Oil on the Fly

ONE of the things that plague the long-distance record maker on road or track is the stop for supplies. When a tire replacement is in order there seems no way out but a recent performance on the Indianapolis Speedway demonstrates that stops for gas and oil are simply a matter of time. The distance for the run was determined in advance being set at 3155 miles—the distance from New York to Los Angeles via the William Penn National Old trail route. All service aside from the tire repairs was achieved from a second car, which took the tank and kept pace with the racing machine at a speed of 50 miles per hour. Inasmuch as the car which first finished the distance in 21 minutes over an even 50 hours at an average speed of almost 60 miles per hour it will be seen that the 50-mile filling speed represented a distinct slowing down on account of the driver. Our photograph shows the process of filling gas into the tank of the racer with the mechanic attending the business end of the hose.

The Heating Value of Gas

TECHNICAL Paper No. 100 of the Bureau of Standards for sale in the Superintendent of Documents, Government Printing Office Washington, D. C. at 25 cents a copy gives the results of laboratory tests conducted at the request of the Illinois Service Commission of Marchand on the relative usefulness of many different heating values and the correct adjustment of burners for changes in the heating value and specific gravity of the gas.

This was a task which was used almost exclusively for lighting purposes and in the ordinances regulating gas companies it was usual to require gas having a certain illuminating value. More recently gas



Motor travel for the legions, in a machine that is controlled entirely by hand

has been used more and more for heating purposes and less and less for lighting or when used for purposes of illumination it is almost always burned in a mantle burner. This was accompanied by a change in the regulations from an illuminant to a heating value and, consequently, it has been found necessary in some cases to reduce the lighting power of the gas due to increased cost and other difficulties of mantle burners.

The present paper deals with a condition thus brought about the tests having been conducted primarily to determine whether the consumers in Baltimore were getting as good gas service with the present stand and of 500 B. T. U. per cubic foot as they obtained with gas of a higher heating value in former days. The tests showed that with proper adjustment of the appliances the service should be as with gas of 500 B. T. U. per cubic foot. The relative cost of the service however under the two conditions was not taken into consideration in this report.

Wave-Length Measurements in Arc Spectra

COMPOUNDS of the rare earth elements which are used extensively in the manufacture of gas light mantles and cover carbons for electric arcs and less extensively in the textile and glass industries for their coloring properties, are about the most difficult materials for the chemist to prepare in a pure state. The chemistry laboratory of the University of Illinois has succeeded in preparing some of the members of the rare earth family in a high degree of purity and has submitted to the Bureau of Standards samples of these materials for spectroscopic analysis. The work on the original comparison of materials is now completed and Scientific Paper No. 495 has just been issued describing the results that have been obtained for the rare earth elements gadolinium and dysprosium. Two preceding



Filling a racing car with gas and oil at fifty miles per hour

papers have dealt with yttrium, lanthanum and cerium and with neodymium and samarium. The spectroscopic analysis confirms the degree of purity attained by the chemists in separating the gadolinium and dysprosium salts from the original materials and in addition affords an accurate estimation of the green yellow and infra-red spectral position of these elements which have only been covered incompletely hitherto.

The data collected from the observations are compiled in two tables, one of which contains about 800 wave lengths in the arc spectrum of gadolinium and the other about 800 wave lengths in the arc spectrum of dysprosium. These data are of value chiefly to chemists who are interested in problems of analysis, to astronomers who are concerned with the chemical composition of the stars and to physicists in connection with atomic structure. This paper can be obtained from the Superintendent of Documents Government Printing Office Washington, D. C. at 5 cents a copy.

A Novel Instrument for Navigators

UNLESS the spirit level and calculator illustrated here with it is believed that the data necessary for proper navigation of the globe (courses are obtainable with the spirit level and calculator) is a novel position determined from a "single observation." What this instrument really does is to set up, in the form of a small model the various astronomical and geographical circles with the position of the ship with reference to them. A horizontal zenith distance and azimuth are read off the zenith circle and the dial and the ship's position is known at once with it calculated. A really difficult part of the astronomer's calculations is the part required by the automatic reading of the instrument.

In the photograph it represents the earth's axis. It is perpendicular to the declination circle B and accurately fastened to the latitude circle C . At D the center of the compass rose we have the ship's position—which is of course unknown to begin with and which gets determined only as the setting of the various parts of the calculator to match the observations made, determines it. The zenith circle E is the zenith distance circle and is held in position by the ship's position. The corresponding between the model and the visible universe with the ship in its center is complete.



A spherical-angle calculator that does much of the navigator's hard work for him



This man is careful where he looks inside overalls where light shows electric cable lamp

This careful miner has hooked the ear with a piece of timber. He does not trust to the brakes alone to hold the ear in place

Miner testing roof as he approaches a fall in his room. He detects loose material by its vibration

Shooper, running ahead to refresh, catches his foot to open fire. A wooden block in floor would prevent this

Some incidents in the life of the coal miner which make for safety or danger

Safeguarding the Miner

Safety-First Cooperation of the Bureau of Mines, the Operators and the Miners

WHEN several mining disasters, such as those which followed the last miners' strike, occur, we must be careful not to draw the conclusion that mining accidents are on the increase, or that no precautions are being taken to prevent them. As a matter of fact, although the great mining disasters powerfully excite public appreciation, there has been an encouraging reduction in the number of major disasters and deaths in coal mines since 1911. In that year 15 coal-mining accidents occurred with a loss of 413 lives, whereas in 1920 eight similar accidents resulted in only 61 deaths, and whereas in 1911 major disasters caused 17.5 per cent of the total killed at coal mines, in 1920 only 2.7 per cent of the total deaths from all causes were due to major disasters. Now the credit for this improvement is due to the preventive work done by the United States Bureau of Mines. We are told by its Acting Director, Mr. H. Foster Hain, that 12 years ago there was no general country-wide service for the systematic training of miners in matters relating to safety, a slight beginning only having been made in a few scattered points. There was no such urgent need for training in those days, for so long as the mines were small and the workers intelligent and well trained in routine mining methods, and when the pressure for output had not yet speeded up the industry to its present pitch, it sufficed very well for each man to look after himself and for the bosses and superintendents to rely upon improved methods when major accidents occurred.

But when the enormous expansion of coal mining brought about the introduction of new and little-tried labor, and when the scale of production was so greatly increased there was a rapid rise in the dangers of mining. The increased output in the mining of today has been obtained from the substantially same number of miners as ten years ago, but the personnel is not nearly so well trained in mining. There was a series of disasters and mine explosions immediately prior to the organization of the Bureau of Mines, and the problem before the Bureau was that of reducing the number and severity of these. To this end the Bureau of Mines sought the cooperation of the State Mine Inspectors, the mine operators, and various other agencies, and while the full benefits resulting from preventive and remedial measures cannot be ascertained accurately by figures only, the statistics, as given above, show that greatly beneficial results have been obtained.

When the work of obtaining records of the injured at the mines was undertaken by the Bureau in 1911, many of the States kept no record of such accidents, and the record showed a small number of injuries reported to the Bureau during the first few years after 1911. The apparent increase in injury reports, which

was noticeable from 1911 to 1914, was due in a large measure to State requirements for reporting such injuries and to the rapid enactment of compensation laws by many States during that period. Today mine oper-

ators from 4.80 in 1911 to 5.00 in 1920. Of late the injury rate has ranged from 294 to 342 per thousand men employed.

A very effective agency in reducing the number of accidents and mitigating their effects upon the injured, is the character and extent of the training which is given to those engaged in mining. Miners who receive certificates of first-aid training are instructed and examined in the anatomy of the human body, the treatment of hemorrhage, fracture, burns and shock, and the transport of wounded persons. Certificates of rescue training are given those who pass a physical examination, who wear breathing apparatus while doing hard labor in atmosphere containing various and irreparable gases, and demonstrate their ability to adjust and take care of such apparatus and to perform the duties of rescue men. The course of training represents a total of 15 hours of intensive work. During the decade ending June 30, 1920, the Bureau of Mines trained 50,971 persons in rescue and first-aid methods. In 1911 the 784 persons trained represented less than one miner in every thousand, but in 1920 the number trained was 8,008 which represented nearly ten miners in every thousand employed.

As regards the causes of coal-mine fatalities, it should be noted that nearly half of all deaths at coal mines result from falls of roof and coal, and most of this class of accidents takes place at or near the "working face," which is the place where the miners actually mine the coal. A few occur elsewhere in the mine, as on slopes and haulage ways. Many of the falls at the "face" are due to failure of the miners to take down loose rock or coal or to set props under dangerous places in the roof.

Mine cars and locomotives underground are responsible for about 17 per cent of all fatalities, the victims usually being run over or caught between the cars and side of haulage way.

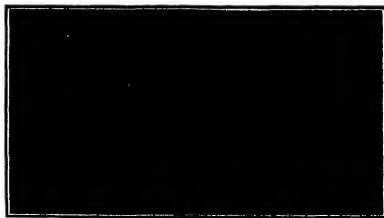
It will surprise the public to learn that mine explosions, although generally given much prominence in the daily newspapers, have caused only a little more than one-tenth of all fatalities during the past decade, and, excepting 1922, the percentage in recent years has been considerably below that mark. Most of the gas explosions have been caused by the carrying of open lights into accumulations of gas, while the explosions of coal dust have frequently resulted from winch or down-out shots or to what, in the absence of dust, would have been local explosions of gas.

Accidents due to powder and other explosives have caused six per cent of all fatal mine accidents, between three and four per cent have been due to electricity, and less than five per cent to miscellaneous causes underground.

Of all fatal accidents at coal mines, about 90 per cent have occurred under-

Diagram shows the injuries to various parts of the body in the proportions revealed by the accident statistics

miners in practically all States must report non-fatal injuries. The Government now obtains accurate statistics both of deaths and injuries. They show that the number killed per thousand persons has decreased



Switch handle is carried back into whitewashed hole in wall. The man is clear of the haulage way and in a safe position

ground, between two and three per cent in shafts and slopes, and slightly less than eight per cent above ground.

A most important part of the safety first campaign of the Bureau consists in the publication, from time to time, of circulars illustrated by photographs which show the miner, and the operator also, what he should do and what he should avoid in the prevention of accident and the safeguarding of life and limb. The excellence of this method is revealed in the half dozen photographs, which we have chosen from a circular issued in 1918 entitled "Dangerous and Safe Practices in Bituminous Coal Mines." These have been chosen from 200 similar photographs which make up the bulk of the circular. Each has beneath it a few explanatory words, and even without these the pictures themselves should convey a clear lesson to that large proportion of the miners of today who cannot read English and are, therefore, particularly liable to injury.

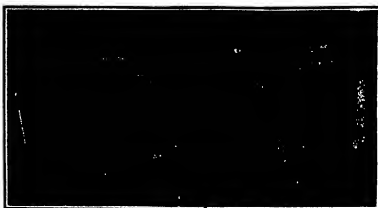
The pictures here represented are selected from those which teach the miners the principles of self-protection through care and forethought, and of these there are some 180 in the pamphlet referred to. In addition to these there are about a score of pictures which illustrate good practice in the equipment and oversight of the mines, such as the provision of miscellaneous safety devices, among which may be mentioned an underground machine shop, sub-mergers' offices which are kept locked, first aid box stretcher and skeleton map of mine so placed that they can be reached from the outside, locked explosive magazines, unident bullet boards, on which an accident which occurs is recorded for a warning to the miners, safety notices placed conspicuously at the roof of the mine, and many similar devices.

Enough has been said to show that this governmental work is highly humanitarian, that it has already, in a single decade, gone far toward making mining a reasonably safe occupation, thus robbing this absolutely essential industry of the terror with which it has too long been associated in the public mind.

A Diminutive Electric Tractor

HERE we have two views of a diminutive and ingenious tractor which for work performed in proportion to its size is certainly remarkable. It was built in Germany in response to the urgent demand for the exercise of all possible economy, particularly in the matter of transportation of materials for the short distances in large industrial plants. Special effort is being made to replace manual labor by mechanical drives of one kind or another, and it is considered that these conditions are well met by this little machine, which is called in German a "Klein Elektrische Lokomotive."

The complete tractor as shown in the larger engraving consists of a steel frame carried on two wheels provided with solid rubber tires. The accumulator battery is in two parts, one carried before and the other behind the axle. Above the axle is mounted a little 1.6 horsepower motor, which drives it by means of a gear, a chain, and a worm drive. The speed is low, being only 3.25 feet per second. The operator walks behind the axle, or one of which is mounted a controller, and he steers the tractor and keeps it on a level keel so as to avoid any tipping. Two small rollers are attached, one in front and one behind the tractor with a small clearance above the ground. The advantages of this little vehicle are found in its small



This miner has set a prop under the frame lip before starting work with his pick.

dimensions, its low weight and the ease with which it is handled. Also it has proved to be very economical, operating at low expense. The ordinary capacity of the battery is 32-kilowatt hours for three hours of discharge, but a single charge is sufficient for two days' intermittent operation under the average conditions of work. The average tractive effort is about a quarter of a ton with a maximum effort of one ton. It can haul up to one hundred tons where the load is running on the level upon steel rails, on average undulating highways it can haul about ten tons, and running on the benches of a canal can haul 400 tons of coal in boats or barges. The tractor is 215 feet wide, 292 feet high and the length over all from the front hook to the end of the shaft is 1278 feet. The total weight is about two tons.

Industrial Use of Powdered Coal

POWDERED coal has been successfully applied and is increasingly used in open-hearth furnaces for melting and puddling furnaces, continuous-casting furnaces for blooms and billets, furnaces for heating, reheating, and forging, annealing furnaces for malleable iron and steel castings and plates, sheet and pipe and annealing furnaces and its use, gas-treating plant, soaking pits, are roasting and volatilizing, copper-ore roasting and smelting, the zinc industry, the gold and silver industry, cobaltic kilns, lime burning, refractory materials and also in the fertilizer industry. It is used more than any other fuel in the chemical industry and has been successfully applied for steam raising. Wherever powdered coal has displaced hard firing the coal consumption has been reduced considerably.

By the term powdered coal is meant coal subdivided so that it may be burned in suspension when mixed with the necessary supply of air and may be conveyed easily by means of a screw conveyor, its compressed air, or suspended in a stream of low pressure air to the furnace.

The principal advantages over hard and stoker firing lie in the comparative ease of conveying coal to furnaces and in the practically complete combustion of the coal, with little excess air, in close contact with the material to be heated, thus avoiding the convection, radiation and excessive losses which necessarily hand or stoker-fired furnaces placed outside reverberatory and many other furnaces. For this reason the most successful field of use for pulverized coal installations has been for those purposes where they have replaced extremely fired furnaces. For purposes such as steam raising,

where the burning coal can give up heat directly by radiation to the boiler heating surface, there is therefore less opportunity for reducing the fuel consumption by burning powdered coal instead of lump coal on a grate, since the losses which may be reduced by substituting powdered coal firing for lump firing or stoker firing are those only which are due to incomplete combustion and undue radiation. These losses, however, are not inconceivable.

On certain drawbacks to the use of powdered coal are cited by the author of the bulletin. Before powdered-coal firing can compare successfully with grate firing it is obvious that the gain due to the smaller consumption of powdered coal must offset the cost of preparing, conveying and burning it.

There is a further disadvantage with powdered coal. In grate firing the ash is left on the grate and in the ash pit. But with powdered coal the ash is blown into the furnace out through the stack, and with some badly designed furnaces out through openings in the furnaces. It may also form a troublesome slag, and fill up the flues so as to impede the draft.

On the whole, powdered-coal plants cannot be said to be clean. There are fairly clean powdered-coal plants, but generally, though not universally, a plant using powdered coal is dirtier than a grate-fired plant.

Powdered coal is better adapted for firing stationary water-tube boilers than other fuels. With these boilers furnaces of sufficient size, and of the correct shape may be constructed, and the gases pass through so tubes wherein ash may settle to obstruct the draft and shield the heating surface. It has been found difficult to burn powdered coal in locomotive and cylindrical marine boilers because the combustion space is too small to permit the coal to be burned completely.

Although men have been killed by explosions and fires in powdered coal plants, the causes of such accidents are known and precautions may be taken that they may not recur. Greater precautions are required with some systems than with others. For instance, dangerous fires and explosions have occurred more frequently with the direct low-pressure air system of transport than with the indirect screw-conveying or compressed air transport systems, although the indirect transport system has not been entirely free from disasters. The possibility of a dangerous fire or explosion in a well-designed and unattended powdered-coal plant is remote and should not influence the prospective user of powdered coal against installing it.

Mining Microbes

A method of killing microbes by the simple means of cutting them into bits is described in the *British Medical Journal*, which states that by this means the bacteria against infectious diseases may be mixed with germs from which the pathogens have been removed. Thus if diphtheria vaccines are used very much larger doses may be administered with increased chances of protection than if the pathogens are not removed. So small that 5,000,000 of them in a teaspoon are invisible and a million only the state of division, this electrically driven machine will cut or smash them. The microbes are suspended in a liquid and forced against a screen of 50 to 100 microns in diameter per hour so that 20,000,000 cuts are made in one minute. As the germs remain in the machine 20 minutes, they receive 500,000,000 cuts.

The Maple Sugar Industry

The Tree that Made Vermont Famous, and How its Delectable Juice is Harvested

By C. O. Orniston

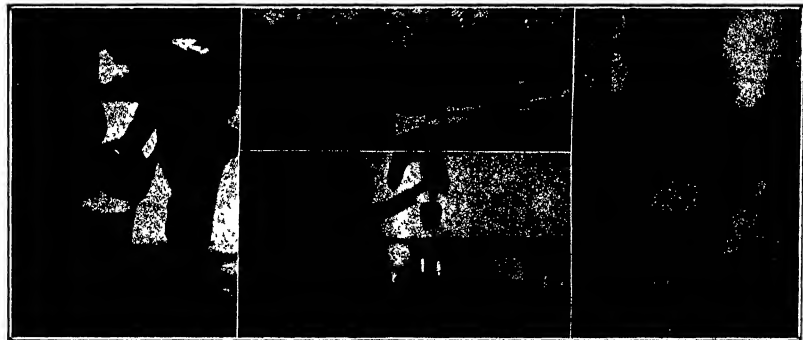
MAPLE syrup is a product of the sap of the maple tree, concentrated by evaporation to a boiling point of 210 degrees. At this temperature one gallon of maple syrup weighs 11 pounds, and, including very small percentages of various other solids, chiefly of mineral origin, contains 65 per cent of sugar and 35 per cent of water. Maple sugar is a product of the same sap, so concentrated, that, upon cooling, it will crystallize and form a solid mass. Maple nutmegs is a form of glucose resulting from the distillation or reversion of maple sugar, when concentrated to a low degree. Maple cakes, maple cream, maple powder and various other pure maple products, consist of maple sugar, variously manipulated, and at various temperatures. And maple lard is a syrup produced by the melting of maple sugar, cane sugar, together with water in various proportions.

Maple sap is obtained by tapping the maple tree. This operation is termed tapping, and while there have been various forms, the method which is now in universal practice is to bore a hole, not exceeding half an inch in diameter, to a depth of from two to three inches, at a convenient height, and in a sound, healthy portion of the trunk of the tree. A metal, tubular

dowel, somewhat of the botanist. This tree is found only in North America, and its range extends throughout the entire valley of the St. Lawrence River and its tributaries, where it is the predominating tree, and westerly as far as Minnesota. From Maine it extends southwesterly, well into the Carolinas, thence westerly through Kentucky and Tennessee, well into Arkansas and Missouri, in which states it spreads, in leaf shape, over an extensive territory.

The Bureau of Forestry is authority for the statement that there are, scattered over this entire area, approximately 100,000,000 maple trees. A study of the returns of the last census reveals the fact that of this number but 15,000,000 are utilized in the manufacture of maple sugar, and that, even including the sugar equivalent of that part of the product that is marketed in the form of maple syrup, the entire output of maple sugar of the United States falls under 50,000,000 pounds annually. Of this amount 87 per cent is produced in the five states of New York, Vermont, Ohio, Pennsylvania and Michigan. The total output of Canada is approximately 10,000,000 pounds annually. It is known that but one-third of the available trees in Canada are utilized, while the numbers of non-utilized trees in the unsettled regions runs high into the millions.

and located near the extremities of the smaller roots. This mixture consists of an extremely weak solution of the various mineral elements, chiefly in the form of nitrates, which enter into the composition of the tree and form the saps when the substance of the tree is burned. It is transferred from the root-hairs into the roots, thence into the larger roots, and finally into the trunk of the tree, in which it is carried up into the branches and into and through the leaves. During its passage it loses, by evaporation, an immense percentage of moisture, which passes off in the form of a watery vapor, and another immense percentage is broken up into its elements of hydrogen and oxygen. Air is also forced simultaneously through the leaves; and during its passage it parts with the carbon dioxide that was intermingled with it, and emerges as pure air, while the carbon dioxide unites with the hydrogen, thus forming starch. The oxygen thus set free emerges in the form of ozone, the insoluble starch is transformed into soluble sugar, as corollas require, and forced back into the sap, which henceforth is known as "sugarwater" sap, and which forms the food of the tree. In this form so much as is needed for immediate growth is carried to points where new tissue is being made, and the remainder is stored for future use.



1 Emptying a tree-bucket of its sap. 2 Gathering saps of sap from the tapped trees. 3 Inside the sugar house, showing the great machines for evaporation. 4 An outdoor sap house. 5 Glimpses of New England's outdoor cold-weather industry—maple sugar production.

sap, so constructed as not to interfere with the flow of the sap, is driven tightly into the tap-hole, and a bucket, made for the purpose and usually of tin, is suspended immediately below the spout. The sap, being forced from the tree by internal pressure, trickles through the spout and falls in little droplets into the bucket below. The buckets usually have a capacity of from 12 to 16 quarts, and it is rarely the case that a sufficient quantity of sap flows to more than fill a bucket during the 24 hours which intervene between the times of tapping. Many maple sugar makers make a practice of tapping the larger trees in two or more places, claiming that a greater amount of sap is thus obtained.

Botanists recognize something like 100 species of the maple tree as inhabiting various parts of the globe. And it is a common characteristic of all of these to yield this sugar-bearing sap if wounded during the dormant period and under certain atmospheric conditions. But, of these, there but one species that will yield the sap in sufficient quantity and purity and of a sufficiently high sugar content, and that is closely enough associated to large numbers to allow the profitable manufacture of maple sugar. This is the sugar maple, the hard or rock maple of the lumberman, the

but the maple tree will yield its sap only during its dormant period, and even then only under atmospheric conditions which include bright, clear days during which the temperature rises well up into the seventies, followed by equally clear nights with a drop in the temperature to several degrees below the freezing point. And because in the north these conditions prevail in the highest degree during the month of April, is the chief reason why this is predominantly the sugar-making month in the north. In the south, however, such conditions prevail to a less extent of variation, but over a much greater length of time; and the sugar season covers several months, with light, daily yields, but with an aggregate considerably greater than the average yield in the north. The average yield per tree throughout the United States, as shown by the census, is a trifle under three pounds. Yet from very greatly in this respect, and a maximum yield of 40 pounds from a single tree has been reported. And the sap from different trees varies in sugar content, a minimum of scarcely a trace to a maximum of 10 per cent, with an average of about 8 per cent.

Briefly stated, the theory of the sap flow is essentially as follows: Moisture is abstracted from the soil by means of very minute appendages, termed "root-

hairs," and located near the extremities of the smaller roots. This mixture consists of an extremely weak solution of the various mineral elements, chiefly in the form of nitrates, which enter into the composition of the tree and form the saps when the substance of the tree is burned. It is transferred from the root-hairs into the roots, thence into the larger roots, and finally into the trunk of the tree, in which it is carried up into the branches and into and through the leaves. During its passage it loses, by evaporation, an immense percentage of moisture, which passes off in the form of a watery vapor, and another immense percentage is broken up into its elements of hydrogen and oxygen. Air is also forced simultaneously through the leaves; and during its passage it parts with the carbon dioxide that was intermingled with it, and emerges as pure air, while the carbon dioxide unites with the hydrogen, thus forming starch. The oxygen thus set free emerges in the form of ozone, the insoluble starch is transformed into soluble sugar, as corollas require, and forced back into the sap, which henceforth is known as "sugarwater" sap, and which forms the food of the tree. In this form so much as is needed for immediate growth is carried to points where new tissue is being made, and the remainder is stored for future use.

Maple sugar is identical in its composition with cane and beet sugar, and were it reduced to a state of absolute purity it would be indistinguishable from these but would possess no more value. But consequently it is never so reduced. It owes its superior value to the presence of an elusive essence of a most deliciously delicate flavor, and whose elements have as yet been unable to isolate. And, contrary to the opinion that is prevalent in many sections, high-grade maple sugar is of a very high, almost white color, and maple syrup is almost transparent in its clearness, with a barely perceptible yellow and delicate flavor. The dark-colored, almost syrupy or opaque maple syrup, which is a low-grade product, ready to go off in fermentation, is a common and historical product, developed by careless and unsanitary methods of concentration.

For maple sap, as it comes from the tree, is no value (Continued on page 177)

Whole Wheat Bread-Without Flour

MAN has made bread by several methods—and none of them has been right. The most recent contribution to the methods which may be grouped under the term "the modern utilizing industry" is the claim of this industry have been more commercial than hygienic.

An examination through the microscope of a grain of wheat will reveal that there is a white central portion, protected by two envelopes. Between these envelopes is a brown substance. Outside them is the bran, which is not a food substance. The modern flour mill has been operated with the sole aim of insulating a white flour, and with this in view only the central part of the grain is retained, the cylinder machinery eliminating the two envelopes and the material between them. But the fact is, that in this space between the envelopes lies the major part of the nutritive value of the berry, and all its vitamins. All this is discarded in the effort to get a white flour and a white bread.

The test of the vitamin content of food is a simple matter. It has long been known that pigeons, in co, rats and guinea pigs, fed solely on ordinary white bread and water, die from lack of essential elements of the diet. At the same time it is known that the prevalence of rickets and bone diseases among undernourished humans is to be ascribed to the absence of vitamins from the ration. Because of this lack in the ordinary white bread, one could gorge himself on this food and slowly starve to death.

For many years specialists have been trying to retain all the nutritive elements of the wheat berry, while keeping the bread white and soft. Kneif made white bread in this way, but it was not soft—it required supernatural leaven for its sustenance. In fact, a later scheme, known as the Hesp-Mount method, failed because of the elaborate process of fermentation of the grain which it employed. A new system now put forward in France, however, gives great promise of providing the white. It eliminates all slow stirring to free the grain of the bran, and in three distinct operations of washing, maceration and sifting, which can be carried on continually, in a machine whose cost is as low as to be within the reach of the miller has developed a practical way of converting the gluten and the vitamins of the wheat.

The washing not only cleans the grain, but makes it easier to crack the bran and peel it off from the kernel (but retains the nutritive elements). After the washing, the clean wheat is macerated to bring it to the necessary degree of hydration. Sifting then refines the ordinary milling process, separating the bran from the pulp and leaving the latter with the highly nutritive portion between the outer envelopes.

The most startling feature of the new process is that its product is not a white flour, but a whole wheat berry just as it now goes from the mill to the domestic economy, and of the flour mill from the industrial establishment. It contains everything the whole wheat berry just as it now goes from the

threshor to the mill, that she pour these kernels into her machine, and receive out of it the dough for her bread. All the nutritive value of the wheat are retained, and the useless and indigestible chaff is discarded at the same time. The machine is not larger than the ordinary family washing machine, and like so many other household utilities it can be operated with the current from the most electric light socket.

The main part of the machine consists of a large perforated drum into which the wheat is poured through a funnel. The grain goes through a continuous crushing process inside this drum, accomplished by means of rotating cylinders operated by a four-horsepower motor which produces from 25 to 30 kilograms of dough per hour. While the dough is thus being prepared in a preprocessor in the bottom of the drum while the dough leaves simultaneously from another opening. The dough is gooey for the usual leavening process, and in half

Internal view of the machine that makes dough from the whole wheat berry. The cylindrical drum is removed to show the rotary crushers

an hour may be put in the oven. The bread thus obtained has an agreeable taste, it is not pure white for it contains the inside cover of the wheat kernel. It is more probable, however, that the housewife of today is educated beyond the point where a snow-white color stands in her eyes as the hallmark of purity and quality.

While the experimental work has been done entirely on the home-made model, the new method does not necessarily demand that the housewife make her own bread. The machine will presumably be obtainable in large scale, suitable for bakeries of even magnitude from the small village establishment up to the factory that makes bread for a city. This factory will derive the same advantage in making direct from wheat, and in making bread with all the wheat in it, that the individual housewife would enjoy.

The two figures in the new development are Maxime Pédale and Navarre, two well known French scientists and engineers.

Measuring the Drying-Time of Varnish

THEIRIKS have been devising a series among producers and consumers as to the drying time of paints, enamels, oils, and various varnish products. Many of them have been due to the fact that the method of determining the dryness of a film (including every hour with



French and English leaves made by the new process, retaining all the vitamins

the finger) has not been well defined, and especially to the fact that observations could not be made with regularity over the drying period which often occurred late at night. In an attempt to overcome these two factors, Mr. H. A. Girdner of the Paint Manufacturers' Association, has experimented for several months to develop an automatic drying time meter. Several types were designed and constructed before one that would give satisfactory results was developed.

It will be noted in the illustration that the apparatus consists of an alarm clock device fastened on an upright base. Attached to the long hand of the clock is a very lightly constructed wire wheel covered with a circular drum formed of light tin plate or of aluminum. The drum is so fitted to receive the test piece upon which the coating is applied. This wheel under the undisturbed run at the top of the drum nail is pressed in contact at that junction with a sheet of soft light tissue paper of the same width as the test piece. Both of these are automatically pulled from an rotating double roller stand, by the action of the clock. Just as long as the coating is wet, it will stain the tissue paper at the point of contact, the stain radiating out radially to the film. Just at the point of true setting of the coating the paper will no longer be stained when it comes in contact with the test piece and will not adhere to it during its subsequent journey around the drum.

The test piece developed for this work after a trial of many materials, consists of a roll of collodion moving picture film (white short ends of undeveloped stock) that has been light struck but not developed. This material was selected because of its opacity (white silver coated surface) upon which, applied their coatings are quite visible. Solvents of various kind of surface, paint and varnish coatings do not penetrate it, but dry upon the surface somewhat as they would upon glass. Moreover, the solvent usually employed in paint and varnish apparently do not affect the film, and they seem to evaporate in the same time as they would from a surface of glass. Solvents of other type or acetone-containing solvents, such as may be used in heavier coats, could not be used. However, such film is of a standard size and character of finish and is obtainable in practically any part of the country at a low cost from moving picture films.

Tarnishing and Detarnishing of Silver

THE Bureau of Standards has recently made an investigation of the tarnishing and detarnishing of silver at the request of the Department of Agriculture. This investigation has shown that the tarnish ordinarily observed on silver is the result of films of which certain colors are characteristic and indicative of the extent of the tarnish. The effect of hydrogen sulfide gas on itself on silver is relatively small, but if small amounts of moisture and sulfur dioxide are present the action is greatly accelerated. Tarnishing is also made more rapid by the presence of alkaline films and soap film. Conditions for producing a standard reproductible tarnish were found, and the weight and thickness of the tarnish film were calculated.

In studying the methods for detarnishing silver special attention was given to electrolytic methods. Most silver is produced when the tarnish is reduced electrolytically and the properties of most silver were therefore studied. The results of the electrolytic method were likewise carried out to determine the losses in silver that occur. The relative merits of solutions used for the electrolytic method were compared in terms of the rate of cleaning and the possible corrosion of the specimen.



The drying-time meter, with last showing a piece of marked film removed from the apparatus after a test of the drying-time of varnish. Note the sharp line at which the tissue ceases to adhere to the film



Left: The rectifying switch mounted on the high vacuum transformer. Right: Closeup view of the air-tight tube that makes it possible to read the actual high vacuum potential across the X-ray tube.

Two major electrical features of the new precision X-ray apparatus

Precision X-Ray Apparatus

New Means of Rectification and Voltmetering that Take the Guess-Work Out of Roentgenology

ROENTGENOLOGISTS today are taking increased interest in X-ray therapy. X-ray apparatus which has been offered as an instrument in the rug has not attained the high degree of engineering perfection which our knowledge of the subject warrants. The medical practitioner is able to have his dosage measured with ease and accuracy within one part in a thousand, whereas his brother, the Roentgenologist, has been forced to measure his in almost unbreakable crude guesses.

One of the variable factors that has not heretofore made itself amenable to precise treatment has been the constancy of the wave-form in rectification. We have heard much about the long wave and the short wave rectifiers, but nothing about the constant form of wave rectifier.

It has been pointed out by adequate authority on numerous occasions that pointed spark gap variations are not always unreliable because of electrical conditions, such as oscillations, which occur in the circuit, but that they are also greatly affected by atmospheric humidity and by changes in operation as the points

sphere gap and not that of a pointed gap. By doing this we may not only eliminate the inconsistency of the needle-point gaps, but at the same time substantially do away with the corona discharge and with the obnoxious generation of ozone and nitrous acid accompanying it.

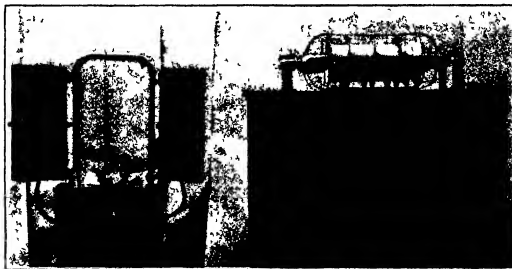
The practical result of some such line of reasoning as is embodied in the above paragraph is depicted in our first photograph, which illustrates a rectifier newly designed and now on the market. The spheres are stationary, and the revolving sphere have been replaced by "toroidal segments"—to adapt a rather thin chemical term—which this in reality generate during that part of their path that covers spaces but less than a full revolution. A further advantage, appearing on inspection of the figure, is that rods are used for all connections. With the spheres for the stationary electrodes and the segmental toroids for the revolving ones, there is no place for corona discharge into the air, and no current is conducted through the shaft.

After we have introduced a rectifier that meets our requirements, the next thing is logically to think of means for accurately measuring the energy developed.

The sphere gap cannot be used as a measuring means, with accuracy, where the circuit have large charging currents. Further, the sphere gap when used as a voltmeter requires such skill as to introduce a considerable personal equation. It is not possible to arrest the movement of the spheres immediately on spark-over, and the reading observed depends upon how soon after spark-over they are arrested. Furthermore, a sphere gap cannot be read continuously during treatment, for it requires marking over, the noise of which may frighten the patient, and, moreover, it necessitates turning off the current to extinguish the arc—which is quite impracticable.

When Fortescue first suggested the sphere gap as a means of measuring voltage, it was necessary to devise a means of calibrating sphere-gap voltmeters. The instrument employed—in fact, devised—for this was a precision air condenser, having its discharge measured by a galvanometer or a milliammeter, the latter being calibrated directly with coarse kilovolts. Utilizing this device, we have a direct-reading crest kilovoltmeter which may be read at all times without disturbing the line conditions, and which will be independent of the line-charging current as well as of personal error due to manipulation of the apparatus.

Accordingly the manufacturers of the precision X-ray outfit with which we are engaged have developed this air condenser in a form suitable for use on the instrument as a voltmeter. As a sphere gap is included as a limit gap for the machine, and further as a means for checking one crest measurement against the other if desired. Thus we have finally a constant form of rectifier which may be depended upon, a direct-reading crest voltmeter, and a precision milliammeter which insure the best accuracy possible. The whole apparatus ought to be of constant precision in all its parts. X-ray practice upon a basis of precision far beyond anything which we have heretofore approached in this important field.



Left: The mechanical fan, emphasizing the complete insulation and the absence of live surfaces. Right: The completely assembled machine, including the rectifying switch, above which is inside the cabinet.

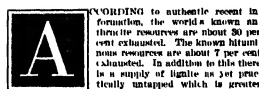
The external aspects of precision X-ray apparatus now at the disposal of the practitioner

has the characteristics of a

Our Reserves of Energy

The Heat and Power of the Future, Seen from the Brighter Side

By Leo G. Hall



FOOTING to authentic record in antiquity, the world is known as thus: its resources are about 80 per cent exhausted. The known bitumen resources are about 7 per cent exhausted. In addition to this there is a supply of lignite as yet practically untapped which is greater than the bituminous supply. It is about a hundred years since coal supplies began to be tapped in any great degree. At this period about a sixth of the known coal supply has been used. How much unknown coal is stored when no one knows. That there is certainly a considerable reserve in the unexplored regions of Siberia, China and Africa.

Additional to all this there are great jet basins on all of the continents which with the improved methods of mining now being put into use in Germany will form still another fuel reserve. I do not mention oil and natural gas, for they have as yet formed an important part of our energy requirements, and they are already apparently within an accessible distance of exhaustion.

We are paralleling our fuel demands year by year. Every year new more used than the year before. If that process keeps up indefinitely, it is, of course, only a matter of time before mankind will be exhausted. But it will take much more rapid pyramiding than has occurred in the past to exhaust the coal, let alone the lignite and peat, within the life time of any person now living.

Economic factors will, however, gradually enter the field and they are already doing so. Coal for fuel time before the supply is exhausted. The coal we have mined to date has been that within reasonable reach of the surface which can be mined at lowest cost. As these easily mined supplies are exhausted, the cost of coal will go up. This rise in price may be regarded somewhat by the improved methods of mining but it will mean the loss of an infinitely the cost of power from coal will exceed the cost of power from other sources not hitherto developed because not hitherto considered economically worth while. And on fast as these other sources of energy are developed, they will be worth while than coal power they will supplant coal power. The cost of coal power does not need to go very much higher before there are large blocks of it that other energy are thrown into competition with it. It will interest us later to see what other large supplies of power are available.

The first and most vital of these is, of course, the power of rivers and waterfalls. Engler, I believe has estimated that the energy which might be taken economically from these waterfalls is sufficient to replace the coal of the world's present coal demands. Note that the word economically. Recent developments of electric low head turbines have already brought a larger portion of the world's watercourses within the economic field and Engler's estimate is already out of date and too low. A large part of the world's potential water power is of the low head type. And Engler's figure should be increased by about one-third to include this.

With a comparatively small increase in fuel price, other developments not included in Engler's estimate of means of high cost will become economic competitors of coal and will be developed. Developments now carried to only a quarter or a third of potentialities will be increased to full capacity when the price of power warrants it. All in all, with the price of fuel but little higher, there will be power economically available from rivers and watercourses not much of it, all, short of the total fuel power requirements of today.

While it has been obvious that much of this power is too far out of the way for use, it is also one of the laws of economies that "if the mountain were to come to Mohammed, Mohammed would not come." That is, no wholesale changes of mass of industry would be necessary. High tension transmission of current for a thousand miles is within the range of possibility. Its commercial transmission over several hundred miles has been an accomplished fact for many years. In addition to the total power of rivers and waterfalls, there is a vast store of perpetual energy in

the tides. Recent developments of efficient low-head turbines have rendered the development of tidal power economic, and several very large tidal-power plants are under construction in Europe today. The high tides of Nova Scotia are also being utilized for considerable development in progress.

It is hard to say how much power is available by this means, but it is safe to say that a majority of the world's tidal outcrops and narrow mouthed bays are capable of development as well as to furnish their thousands of horsepower each. Probably power can be developed from tides in excess of what can be developed from rivers and waterfalls. And a large part of this power could compete in the open market with coal even at present prices.

It is of an rate certain that the above two sources of power alone are more than sufficient if completely developed, to replace the world's entire coal consumption and meet growing demands for many years to come that we have not begun to exhaust available sources of energy.

Now, about fuel heating and the replacement of liquid fuel for internal combustion engines. The answer to this question is, I do not refer to the endothermic machines which are now being associated with sun power, but to nature's process of storing up sun in the sunlight, and then releasing it in the plants, and the utilization of it by converting those substances into alcohol which can be used for fuel. Alcohol can be produced today at a cost, power unit for power unit,

EVERY little more well-timed alarm tells us that our fuel resources are within thirty or thirty years of exhaustion. He then draws a long word picture of the sun and stilled wheels of industry. Consequently there is a widespread popular belief that the next twenty years, or fifty at the outside, will see us in the cold unless we take immediate strenuous measures to utilize other large supplies of energy. Now this is mostly nonsense. Without repeating statistics already published at length, Mr. Hall calls attention to some general considerations showing that we will never exhaust our available supplies of coal or even suffer from a serious fuel famine, and that even if the worst we should have to face definite exhaustion of fuel resources five years from today, we could prepare for the jump, in the present state of development of the arts involved, with no serious suffering, and with much less hurry than we understand during the great war.—THE EDITOR.

about a third of the cost of gasoline. It can be used in any gas engine with a small adjustment of the carburetor.

Germany today produces her millions of gallons annually of fuel alcohol, almost entirely out of waste products. In the U. S. in this country are accustomed to associate alcohol with luxury prices, and the government restriction has made the cost high. But we are the only large nation that is so restricted, and the time will come when we shall have to turn ourselves on a par with the rest of the world and permit unrestricted manufacture of alcohol. Already our industries have suffered much of alcohol restriction, even before the enforced hygienic prohibition legislation.

The manufacture of alcohol as a cheap fuel is that it can be made from garbage, animal waste, the rank growths of marshes, weeds, eel grass, and from other organic waste in large quantities. It is now being used by the lives of the present generation the world will be harvesting its fuel crop as regularly as it now harvests food crops, and alcohol will be produced far in excess of present gasoline requirements. Wherever the sun shines there is potential alcohol.

There are still other sources of power which will be put to use on a large scale as economic considerations in the near future. One of these is the solar heat machines which are used in Egypt to produce power for pumping purposes. These are economically worth while in Egypt because of the heat source and expensive. They will become worth while and be put to use on a large scale elsewhere as fuel become more expensive. Recent developments in Germany have brought the cost of solar power equipment down to the point where it is very nearly an economic proposition in parts of the United States and Mexico. The near future will see commercial sun power plants in operation here.

And undoubtedly we will meet up as we live to see giant plants in operation on the shores of the earth, venting their power both to the coast and to the great cities of central United States over high tension lines at a cost of only a few cents per kilowatt-hour by wireline.

The average intensity of radiation received by the earth's surface in Arizona and Nevada during daylight hours for the entire year amounts to about one-tenth horsepower per square foot of surface, or a million horsepower per square mile. Probably not more than 70 per cent of that can be practically realized. But even at that, a single Arizona County could produce power enough to supply the entire power requirements of the United States. I believe that our present demands are about 15,000,000 horsepower. Probably the consumption of the whole world is not in excess of 100,000,000 horsepower. Yet there is solar energy going to waste on the deserts of the world sufficient to supply several billion horsepower continuously, with the proper storage and transmission facilities. It could be done today. It would be done, if the demand were sufficient.

There is scarcely a district in the world that is not within transmission distance of large supplies of tidal power, river power or solar power. And there are still other large available supplies of energy.

During recent fuel shortages several successful wind power plants were built and operated. Recent advances in this line make it possible to connect it with the old cumbersome steel windmill and substitute a sort of wind turbine which is light and strong, and will operate efficiently under a much greater range of wind velocities. Improvements in pressure storing apparatus have made it possible to generate and store a uniform current from the variable wind available supplies of power. The time may come when every household has its wind plant on the roof, with storage batteries in the basement, to furnish power for lighting, heating and cooking. It is economically practicable even now, if people only knew it. When there is sufficient economic pressure, firms will go into the manufacture of apparatus for that purpose, and the thing will be done. At any rate, here we have another large available supply of energy.

Then we have the internal heat of the earth itself to draw on. There are many sources of heat and steam, and will operate in different parts of the world. Exceedingly high temperatures are reached in some places by simply drilling a few thousand feet into the earth. The heat has been harnessed by drilling and then harnessed for practical use to furnish 14,000 horsepower continuously in Montana there is a steamy well where power is heat from natural hot water springs. Most of the mountainous or volcanic regions of the earth could probably be made to furnish power in considerable amounts by tapping them.

I have pointed out above, sources of power which are being developed, or which may further advance in the future, if conditions were such as to warrant their development. It is possible that we may be able to gather certainly supply the power energy demands of our globe many times over.

We have not even begun promising possibilities which are not yet developed—vast stores of power which we now exist, though we have not yet found the key which will unlock them. There is the force locked up within the structure of the atom, which radioactivity has shown us. This is a store as great as to stagger the imagination. Any year, almost any month, may easily announce the "Open Sesame" to this store house of power.

Experimental work is going forward with relation to making artificial heat. That is, finding an endothermic and exothermic reaction which will occur in this place simply under the sun's heat during summer months and which can be reversed rapidly at will in the winter, will unlock them. There is the power of heat. Such a discovery would render the cumbersome and expensive motor machines unnecessary. Some progress has been made in this direction.

(Continued on page 183)

An Automatic Exposure Meter

By Dr. Alfred Gradewitz

CORRECT exposure is, of course, an essential condition of any satisfactory photographic work. In fact, while there is some latitude in this respect and while mistakes in getting exposures can, to some extent, be made up by skillful development, a large percentage of both amateur and professional work is spoiled by improper exposure. The main difficulty in this connection is due to confusion, the bright sun of some gives portions of the objects or scenes to be photographed being overexposed, rather than that of the entire picture as a whole.

Thus suppose the water-scape here (it is to be photographed, the circular frame being, in each view, left out of account). The time of exposure should be so chosen that the darkest portion of the picture, the fringe of the forest in the background, is reproduced with some detail. On the other hand, exposure should not be prolonged sufficiently for the brightest portions of the picture, the sails, to be over-exposed so that the more delicate shading would be reduced to a uniform black on the plate and a correspondingly uniform white on the positive print. Generalizing the time of exposure should be in any case, be so chosen as to keep the exposure our respecting to the brightest portion of the picture below a given maximum and its exposure corresponding to the darkest portion above a given minimum.

This is the fundamental principle underlying the construction of Dr. Schlichter's new actinometer. In fact, when pointing this instrument, which in outward appearance resembles a small telescope, at the scenery to be photographed the picture seen through a blue filter surrounded by three checking sectors, as in our example—a bright a medium and a dark one. The fourth sector corresponds to complete darkness and is not used for checking purposes.

The checking sectors are so graded with regard to one another as to correspond exactly in brightness with respective degrees of illumination of which an exposure ends, at which normal exposure is at its median point, and at which over-exposure begins. Accordingly, in a striking manner, they define the range of correct exposure. The photo-metric balancing of the brightness of the picture with the checking sectors is effected by turning the milled ring A, and through it the iris also, so as to have no portion of the picture remain brighter than the leftmost, and no portion darker than the darkest of the three checking sectors. In the sample picture here used, which is rather rich in contrast, the sails should be of about the same brightness as the fringes of the forest; as dark as the darkest checking sector, while the water should receive the average tint corresponding to the median-brightness sector. The adjustment thus obtained is read from the scale B. This balancing operation reduces the picture as a whole to a single brightness.

Now, the light serving to illuminate the checking sectors is nothing else but the daylight in the space in front of the instrument. Its absolute brightness can be ascertained by gating the blackening time of a strip of photometer paper visible at the rear part of the instrument. The scale-reading on B and this blackening time are next ad-

justed to one another the ring of being turned until the two figures appear beside one another on the left hand scale. The proper time of exposure is then read from the main ring (on the right hand scale) at the point that falls opposite the number corresponding to the objective stop used in the camera.

The instrument has the shape of a small telescope



The transmitter that would make the new alphabet applicable alike to cables, land lines and radio

and is mostly made of light metal, thus weighing only about 1.20 grams. The main dial-like feature, as compared with other actinometers is the elimination of the sensitiveness of the eyes and the direct balancing of the phases of the picture with the blackening time of the photometer paper. In fact the instrument constitutes an actual photometer of known accuracy and, accordingly, eliminates all personal equation

and attempt to correlate the actual reading of the dots, dashes, and spaces with the phase of the electric current entering the transducing antenna. The telegraph key is opened or closed without regard for the phase of the current. Thus, in the transmitting case of one message a relatively large supply of electric energy in the antenna may be interrupted at widely varying values—from zero to maximum, positive or negative. Many of the existing disturbances in the ether, which mar the audible reception of radio telephone messages, are blamed on this. An abrupt breaking or introduction of high impedances in an electric circuit, using alternating current, produces transient phenomena ultimately resulting in the floating of the ether with "musical" or harmonics. Coupled with this condition is the irregular procedure of operating powerful radio-telegraph stations.

Doing Away With Dots and Dashes

By S. R. Winters

SWEEPING revision of the method of transmitting the Morse alphabet with respect to radio telegraphy, land line telegraphy, and submarine cabling, was recently outlined by Major General George O. Squier, Chief of the Signal Corps of the War Department, in a lecture before the National Academy of Sciences. The modified system of signaling would reduce the varying time-periods of the telegraphic dots, dashes and spaces

to a common duration. Dots, dashes and spaces would be obliterated but its duration but its variation in the intervals of the signals. The different intensities in a dot dash, or space, under the proposed system of signaling, would be effected in the use of alternating electric current. Each half cycle or arbitrary multiple of a half cycle would represent one of the three individual and unequal elements, depending upon the intensity. These different intensities are, of course, accomplished at the transmitter. This improved method of transmission has already been subjected to experimental application to submarine cables and a means provided for interpreting the alternating current into understandable signals. Gradually, differing from the present system of the sending of the international Morse code, in the system being described no two adjacent signals are of the same sign, each semi-cycle is employed to obtain signaling affording a dot, dash or space.

The Code Section of the Signal Corps of the War Department in applying this novel form of telegraphic alphabet to submarines (calling observed that "Other things being equal, the variations in intensities for each of the three elemental signals are reduced to the minimum on the theory that the minimum possible change of the fundamental wave should be made. An alternating current in the steady state with its amplitude to a series of the present code letters "e" or "n" strung together without space can attain a speed in any form of telegraphic language greater than any practical system. For the reason that a single sine wave is transmitted through any form of electrical circuit without distortion of any kind and, in fact, is the only type of wave that is so transmitted."

In striking contrast to this contemplated system of telegraphic signaling in the method of transmission of the powerful radio-telegraph stations, for instance do not attempt to correlate the actual sending of the dots, dashes, and spaces with the phase of the electric current entering the transducing antenna. The telegraph key is opened or closed without regard for the phase of the current. Thus, in the transmitting case of one message a relatively large supply of electric energy in the antenna may be interrupted at widely varying values—from zero to maximum, positive or negative. Many of the existing disturbances in the ether, which mar the audible reception of radio telephone messages, are blamed on this. An abrupt breaking or introduction of high impedances in an electric circuit, using alternating current, produces transient phenomena ultimately resulting in the floating of the ether with "musical" or harmonics. Coupled with this condition is the irregular procedure of operating powerful radio-telegraph stations.

(Continued on page 218)



Left: The complete apparatus. Right: Typical example of what one sees in the eye of the actinometer, with the reference frame

The automatic exposure meter and the way it works

Relics of the 1840's

An Interesting Chapter from the Early History of the Telegraph

By A. A. Hopkins

The point in Fort Washington Park from which S. F. B. Morse strung his experimental wire across the Hudson

AS WE walk along Riverside Drive in the neighborhood of 196th Street, New York's beautiful river drive, we look down on what seems to a stranger to be a ruin. A single old mansion swept into a circle of retaining wall by some strike of the tide. Not so to those who live near by for they know that Audubon spent his last years in the house, and that here Morse carried on many of his experiments in long distance electric transmission.

In 1842 John James Audubon, then 62 years old, purchased a tract of 24 acres for out of the city and on the Hudson's bluff bank. Audubon thought that at last he had an idyllic spot to pass the remainder of his days and, accordingly, a building broke, and a tiny outfall. "He named it 'Minnie's Land,' 'Minnie' being the South word for mother. All went well for a time but the railway planned for an entrance into the city, and who had take the water level and travel along the river? Soon the beautiful sandy beach was cut through ruthlessly and Audubon had to build a piazza on the other side of his house to hide out the new symbol of civilization. Of course Audubon was advancing in years, but he still painted in a room on the north side of the house where the big window is now, and here some of his exquisite pictures of birds and animals were executed.

To this house came as a welcome guest another painter of no mean order, although a portrait painter. His name was Morse, and he was dabbling in electrical experiments. The laundry on the north side of the house, on the cellar level, was given him for a laboratory, and even within the memory of men now living here plays of wire been picked up from the ruins of the telegraph. Morse is strangely absent in the biographies, but it is probable that he had already made his basic invention before coming to see Audubon, at any rate this dingy laundry was entirely headed up in an important link in the history of long distance transmission. Mr. Reginald Pellham Bellini, a historian of New York, whose garden leads into the contracted Audubon park, took the writer on a most interesting excursion to find where Morse crossed the Hudson with his aerial wires. A walk of about a mile led into neglected Fort Washington Park, and after crossing over the railroad by an open cut, which must have been a triumph of engineering in the early days, we began a search for the rock where Morse stepped his mast. At last it was found, and after the leaves and earth were dug out we were able to photograph it and also the eyeballs for the guy-ropes some distance away. The mast must have been of great height as the hole in the rock is over two feet in diameter, and while not deep served to hold the mast thoroughly firm and upright, with the aid of the guy ropes. An early work on the electric telegraph describes some of the difficulties encountered as follows:

"For a long time the dispatches were carried over the river by messengers in boats, but finally, the line was discovered by Mr. Ezra Cornell in wooden pipes, the wire being covered with cotton, and insulated with India rubber." This was November 20, 1846. There were two cables then, from New York to New Haven, which were worked very well for several months, until they were carried away

by the ice in 1848. They crossed the Hudson at Fort Lee, some 12 miles above New York City. When these cables were broken, high masts were erected and wire upon them was stretched across the river. Men were in attendance all the time to repair the wire when broken by vessels. It was the custom to let the wire down into the water for vessels to

pass and then to draw them up again. This was practicable in tide water, but not so with the inland rivers. The Hudson river at the place of crossing was 2700 feet wide. These masts were constructed under the direction of Mr. Henry J. Rogers, the energetic superintendent of the telegraph. In 1847 another effort was made to cross the Hudson with a cable, and

past the Audubon House, and along New York's "back yard" as it were. Much of New York's freight, especially foodstuffs, still comes in by this route, and one passenger train a day still crosses the river on what the efficiency brought on by the war rendered it unnecessary thus to protect the franchise. Audubon himself lies buried in the eastern section of Trinity Cemetery, a few hundred feet away. The Audubon House should be preserved as a monument to a great naturalist and a great inventor, but the ravages of time will soon wipe out this very interesting landmark.

Something About Calories

WHEN calories are mentioned in nutrition, it is from the point of view of food fuel value. The calorie value of a diet is a factor of great importance in nutrition. Frankland (1890) was the first to determine this for various foodstuffs by oxidizing them in a calorimeter. He did not express the results in "calories" but rather as "heat units," which, however, had the same value. Robinson (1899) and Reimer (1883) were apparently the first to use the term calorie as it is now applied in the science of nutrition. Rubner made three outstanding contributions regarding the calorie in nutrition: (1) He settled its present-day meaning to the term, (2) he determined the calorie value of protein, fat and carbohydrate, figures which are widely used in determining the energy content of a diet, (3) he drew the distinction between the absolute and physiological heat values of foods. By absolute heat value he meant the amount of heat yielded by a substance when oxidized in a bomb calorimeter; the amount of heat produced by the substance in question when burned within the animal body he recorded as its physiological heat value. These values may or may not be identical, a fact which is of fundamental importance in the science of nutrition.

Calorie as a new word explains nothing. It is a symbol for an idea, however, which, as we have seen, has undergone changes brought about by the development of several sciences. Ancient and hazy notions regarding the phenomenon of heat and combustion first contributed to this idea, reaching its present-day definition by the clarifying influence of Lavoisier. The broad generalization regarding the conservation of energy, played a decisive role in the evolution of the idea. The history of the calorie in nutrition, therefore, is wrapped up with the history of nutrition itself and the fundamental natural sciences upon which this branch of knowledge rests.



The famous Audubon House on Riverside Drive, now left down in a hollow far below the permanent grade, and falling to ruin. In this house Morse did much of his work upon the telegraph.

to that and a copper wire, covered with gut-percha by Mr. B. T. Armstrong, was purchased and submerged by Messrs. T. M. Clark and J. W. Norton for the Magnetic Telegraph Company. The cable was placed across the river at the foot of Cortlandt Street. It worked for just one day, and was then torn away by an anchor

"On the line constructed by Mr. Henry O. Reilly throughout the great west, many rivers had to be crossed, over which the wire was stretched. The widths of these streams were from 1000 to 8000 feet. The first crossing was that at Wheeling, over the Ohio river, 1800 feet, the next was that over the Ohio at Louisville. The latter was one of great expense."

So the railway and the telegraph were early placed in close relationship, Morse's mast overlooked a significant engineering work, for the time. This, the only railway into New York proper, was for a long time along the Hudson, the track crossing through Eleventh Avenue to the depot at 80th Street, and here Lincoln's body was brought through the cut and

ing force in the construction of the telegraph. The history of the conservation of energy, played a decisive role in the evolution of the idea. The history of the calorie in nutrition, therefore, is wrapped up with the history of nutrition itself and the fundamental natural sciences upon which this branch of knowledge rests.



One of the holes to which the guy ropes for the mast were secured in 1846. It was found by men who will search for it.

A Flexible Clutch for Marine Diesel Engines

AMONG the new features introduced into United States submarines recently completed is a new type of flexible friction clutch. The basic principle involved is that of the application of friction between two grooved surfaces, one being the inside of a drum and the other, the moving surface, being a series of shoes moving radially from the center of rotation. The convoluted surfaces are to give increased friction in a minimum of space.

The special problem arising in submarine operation, at which the new clutch is directed, is the need for a connection that will allow flexibility in case either the motor or the engine should be subjected to misalignment, following any deformation of the ship's structure from her conditions, pressure when submerged, or wear in the bearings of either of the main elements. It was also necessary to have a connection, that would absorb or deaden vibrations in case the flywheel of the engine, acting in opposition to the rotating weight of the electric-motor armature, should introduce torsional vibrations in the intervening shafting, resulting in crystallization and breakage. Also there was need of a connection capable of engagement and disengagement while under way.

During the war the problem here stated was acute, but was solved only in a temporary fashion, by use of a clutch of the multiple jaw type, in which the design was held down to the simplest possible standard to facilitate manufacture. There were in this clutch forty or more jaws, to make engagement possible with only a slight amount of turning to get the jaws into alignment. The new clutch is designed to transmit normal load at about 1000 revolutions, with 90 per cent overload capacity. It was first tested in the United States submarine S-2, one shaft retaining the old multiple-jaw clutch while the new one was mounted on the other. The vessel was sent to sea under the most severe weather conditions, with orders to stay out for 46 hours, and to disengage and engage the clutch at regular intervals. This was a sort of authorization to break the clutch if it could be broken.

The new clutch came through this ordeal with flying colors, and it has since carried the S-2 on a voyage of 3000 miles from Portsmouth, N. H., to Hawaii—the longest straightaway trip by a submarine. The contractors, as a result of this, have been instructed by the Navy Department to equip all subsequent submarines with the new clutch.

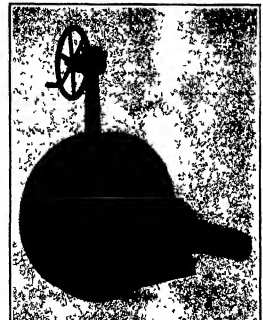
To appreciate the importance of having, on submarines, a clutch as safe as yet substantially as does the clutch on an automobile, it must be noted that when coming to the surface from a submerged run the vessel, if equipped with a plain jaw clutch, must apply the brakes to the propeller shaft in order to bring the jaws in line with each other before engagement. In the presence of an enemy this loss of time may be fatal. Vice versa, when diving, disengagement can commence before actually stopping the engine, the motor get under way in advance and engaged without stopping the propeller, again saving valuable time.

Referring to the drawing, the clutch operates in accordance with the following description. A series of shoes *B* move radially in planes; the guides *D*, *F* and engage the beveled inner surfaces of the friction drum *A*. The drum is primarily of hard cast iron, the shoes of soft, and the shoe-carrier *E* of brass. The guides *D*, *F* are mounted on the shoe and shoe-carrier. The sliding shoes *B* are connected with each shoe-carrier by means of an adjustable link *G*, with a pin in



The United States submarine S-2, driven by the new clutch that engages and disengages in motion, just like an automobile clutch

each end, and with a helical spring *H* mounted on each link to permit of adjustment in proportion to the load to be carried. This adjustment is effected by



General view of the new clutch, showing the radially-moving shoes

dismounting the cup *P* and reinserting the guides *D*, *F*. When the drum is engaged, the link first moves the shoe radially outward until the friction surfaces make

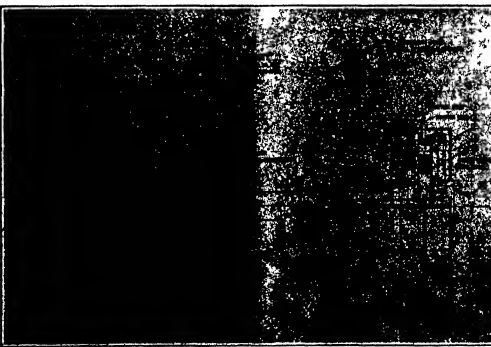


Diagram showing operation of the flexible clutch; the reference letters are explained in the text

contact, then continuing in its motion, it compresses the spring until the proper tension is reached, in proportion to the load to be carried. The hole for the pin in the outer end of the link *G* is elongated to allow play between the link and the shoe-carrier. This relieves the tension on the spring when the clutch is released, and allows the link to pull back the shoe when the load is withdrawn.

When the shoes wear down, the link *G* can be adjusted by withdrawing the lower pin and unsewing the lower link *A*, until the desired length is obtained to compensate for the wear. The friction shoe

B, carried by the shoe-carrier *C*, is so constructed as to permit sufficient lateral movement to allow it to center itself into the grooves of the rim. The driving member *E* and the driven member *F* are not connected to hold the center rigid, as if the steady bearing, by some unaccountable reason drops slightly, the flexibility of the springs will permit the clutch to run still engaged.

The counterbalance weights *B* offset the centrifugal force of the shoe and shoe-carrier, and facilitate clutch disengagement when in motion. The worm-drive mechanism *V-G* is used only for large powers. The worm-wheel *V* runs between heliolith surfaces in the casing *M*, and also the shifting shaft *O*. It is not necessary to run this clutch in an oil-bath, though liberal lubrication is required in order to ensure the proper over-riding-slipping regulation.

Friendly Germs

OUT of about two thousand kinds of bacteria only about one hundred are believed to be harmful. Without the other nine hundred it is on the earth would soon die out. We, as well as the animals whose flesh we eat, derive all of our sustenance from the vegetable world. Plants and animals should contain humus, and humus is brought about by the decay of other plants, which in turn is caused by bacteria or germs. Without humus, plants would themselves very slowly, so that if we were to kill all bacteria no more decay would take place. The soil would soon be exhausted and we should all die of starvation.

In a more ordinary way there are many bacteria which are of use to us every day. They produce vinegar. Lactic acid germs give the flavor to butter. Germs help make cheese. They help digest the food in our stomachs. And, finally, they cause blood to ferment into alcohol, even in the United States with its adverse legislation.

Harmful germs of many kinds are always in our system, and this causes many people to worry, often unnecessarily. The fact that they cannot possibly be eliminated, even if it were possible to get rid of them are should be in danger of killing with them the many good germs we must have in our bodies in order to live. The first germs our most carefully provided food meets with are ptomaine and eptomaine, which are always in the saliva. Without them we should all be chronic dyspeptics in a short time, for they attack our food in a most satisfactory part of digestion. Therefore, efforts to keep the mouth "germ-free" with tooth-pastes would be unwise even if they could succeed. However, when the germs are destroyed by the dentrices a new supply is very soon brought in from the saliva glands. And through the breath millions of new germs of the harmful sort come at once. If we keep our bodies in good health, however, germs will give us little trouble. It is only when they are present in abnormal quantities, or when our resistance goes down, that they menace us.

Making Wrought Iron a New Way

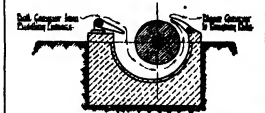
A Mechanically-Operated Puddling Furnace which Does Away with Much Manual Labor

By Prof. Albert Sauveur

SIMPLER is the operation required for extracting a small mass of metallic iron from rich ore than that the principal mass may have discovered it by means of a fire steel accidentally lighted upon ground where iron ore existed near the surface. Indeed, the first iron furnace of which we have any record consisted in a single excavation dug on the side of a hill facing the prevailing wind, with an opening at the bottom for a draft. The treatment in this crude appliance of some rich iron ore mixed with charcoal resulted in the production of a small, rusty lump of iron mixed with slag, that is, of wrought iron. The simple furnaces which later displaced these rough devices were known as forges or bloomeries. A forge of this kind was used for many years in the United States; the furnace employed being known as the American bloomery. The operation lasted about three hours. The iron bloom produced weighed from 800 to 400 pounds, and the charcoal consumption was about 2½ times the weight of the bloom.

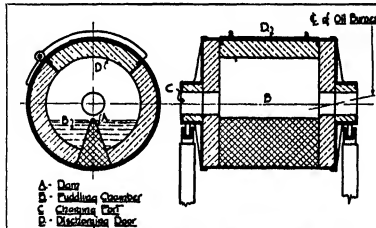
Such processes are known as direct, because they yield a malleable metal in a single operation from the treatment of the ore. They remained the only method of obtaining iron until the fourteenth century, when the blast furnace came into existence. In this furnace the treatment of iron ore with a suitable fuel and with flux yields a product known as cast (pig) iron, which is not malleable. In order to convert it into a malleable metal (wrought iron or steel) it is necessary to deprive it of some of its impurities, notably of the large proportion of carbon it contains, an operation known as refining.

The refining of cast iron was first performed in a simple furnace not unlike the forge and bloomery used for the direct extraction of iron. The method was called indirect because it required two distinct operations in order to obtain a malleable metal. In these furnaces pig iron was heated in contact with charcoal and subjected to the oxidizing action of an artificial blast which caused the expulsion of the carbon and other impurities and thereby the conversion of the pig iron into wrought iron. These "indirect" remained the only method of converting pig iron into wrought iron until the invention by Cort in 1784 of the puddling furnace. The greater economy of this new process caused the former method to be discarded. In the puddling process the pig iron is treated on the hearth of a reverberatory furnace, where it comes in contact only with the flame and gases resulting from the combustion of the fuel in a separate firebrick, the metal being decarburized and otherwise refined through the oxidizing action of the



Conversion of puddled ball to bloom, the arrows indicating the direction in which the metal travels

hearth and toward the end of the operation, agglomeration of the metallic particles. As might be expected, early efforts were made to devise mechanical means of replacing this excessive and therefore costly manual labor. These efforts have consisted generally in the design of mechanical rables and of mechanical (revolving, oscillating, rocking) furnaces. None of these appliances, however, proved successful and wrought iron



The new puddling furnace shown in cross and longitudinal section

continued to be manufactured practically as it was in the days of Cort. These repeated failures at cheapening the cost of manufacture of wrought iron and at increasing the output of that metal led many to prophesy that eventually it would be entirely displaced by steel, mild or low carbon steel, which in the Bessemer converter could be produced in enormous quantities and at low cost, unless some ingenious mind solved the problem

Many consumers and engineers continue to use or to prescribe wrought iron, however, in spite of its much greater cost, which is conclusive evidence that for many purposes it is considered superior to mild steel. And it is also obvious that if the cost of production could be reduced and the quantity increased, wrought iron would be used much more extensively. There is little doubt but that many are waiting for this to come to pass in order to shift from the use of mild steel to that of wrought iron.

This willingness to use the more expensive wrought iron in preference to steel is due chiefly to its greater weldability, greater resistance to corrosion and greater freedom from brittleness and from binding of joints. This need of long stranding for cheaper wrought iron and more of it appears to have been met. In the new process the small reverberatory puddling furnace fed by bituminous coal is replaced by a cylindrical revolving oil-fired furnace in which charges of pig iron weighing some 1000 to 1500 pounds may be treated as against charges of 400 to 600 pounds of the ordinary single puddling furnaces. The pig iron previously melted in cupola furnaces is introduced into the furnace and at the proper stage of the operation a suitable amount of scale is added. The arduous work of the puddler who must drag the greater part of the puddling operation vigorously stir or rable the charge, is done away with all together, being replaced by causing the furnace to revolve back and forth, and the liquid iron to flow over a dam which divides the furnace into longitudinally in two compartments. This repeated flowing of the metal over the dam from one compartment into the other causes a thorough mixing of the iron with the oxidizing slag and therefore a quick refining. When the metal comes to the bottom, E, where small solid grains of iron begin to form, the continued motion of the furnace causes the coalescence of these grains into one solid mass which is then discharged through an opening in the furnace provided for that purpose.

This mass of iron mixed with slag, generally known as a puddled ball, is then passed through the rotary squeezer, in which it is compressed and from which it emerges in an elongated form called a bloom. This operation results in a greater compactness of the metal and in elimination of a large excess of slag. The puddled bloom may then be subjected to the ordinary treatment of the Bessemer converter.

It would be of little avail to have devised a method by which to reduce the cost of wrought iron, to increase its production unless the quality of this cheaper wrought iron was in no way inferior to the product of the old puddling furnace.

An examination of the new process has shown the fact that the metal is in every way equal to the product of the old puddling furnace, and some arguments might even be advanced tending to show that it is of superior quality. This process has been exhaustively tested and it has been found that it could be made to meet all requirements and specifications demanded of wrought iron for the various purposes to which it is applied. It can be produced practically as pure as steel, and its mechanical properties are not inferior to those of the best wrought iron bars.

prevailing atmosphere and through the action of oxides of iron introduced for that purpose in the form of a furnace lining known as "refractory," and of additions to the charge of suitable mill scale. From 400 to 600 pounds of gray pig iron are generally treated in the modern single puddling furnace, the operation lasting about an hour and three-quarters and the consumption of fuel (bituminous coal) amounting to as much as about one ton of coal per ton of iron produced. The operation of puddling is very laborious, requiring nearly constant stirring of the fluid, and, later, of the semi-solid or pasty mass, in order to promote oxid-

The cylindrical, revolving, oil-fired puddling furnace that constitutes the basis of the new way for making wrought iron

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News



A half-pend check protector

A Midget Check Protector

WEIGHING but half a pound, this check protector can be carried in the pocket or tucked in the pigeon hole of an office desk. In spite of its small proportions, as compared with the more conventional protectors, it is claimed to be fool-proof and to give real protection. The hard rubber knob, ground to make accurate turning easier, has on its edge all the necessary figures, letters and arbitrary marks. Each figure can be set, and at the same time the handles must be squeezed and brought together. This movement prints the figure in red ink and shreds the paper, thus preventing its removal to the same extent as any of the more elaborate mechanisms. Printing of the check forward for another figure takes place automatically, with the release of the piler handles.

Auxiliary Gas Vaporization on a Large Scale

THOUGH its cycle of operation is rather complex, the gasoline vaporizer which we illustrate herewith does not seem to present any greatly increased probability of getting out of order as compared with the simpler devices for aiding the carburetor, and it has features of novelty which merit description. It starts its operation with an extra tube, let into the top of the gasoline tank, open to the air outside, and extending nearly to the bottom of the tank. As the gas flows or is sucked out of the tank, a vacuum effect is produced in the bottom of this receptacle; and as a result, air enters through the tube described. This air bubbles up through the fluid, and when it reaches the space above the level of the liquid, it carries considerably more gasoline vapor than the air that ordinarily occupies this space.

The gasoline atmosphere from inside the fuel tank, thus abnormally enriched, is sucked through another tube into the "mixer" and past the "stove," which are

jointly numbered "1" in our view. The stove encircles the exhaust pipe, in the familiar fashion. The hot vapor thus produced is led next to the gasoline heater "2." This unit has an inner and an outer compartment. Into the inner one passes the liquid gasoline from the fuel tank or the vacuum tank, as the case may be, on its way to the carburetor. Into the outer one flows the hot vapor from the mixer. This causes the gasoline on route to the carburetor to be materially heated, so that on reaching the carburetor it vaporizes more promptly than is usual.

The hot vapor which is responsible for this is not yet through its work. It passes from the heater to the distributor "3," which is attached to the carburetor under the butterfly valve. When this valve is open, all the hot vapor enters



It looks like a cigar but it smokes like a pipe

the carburetor in perfect form for combustion and forms part of the mixture fed to the engine. When the engine is running idle with the butterfly valve closed, a smaller tube carries the vapor direct from the distributor to the intake manifold, by-passing the carburetor.

It is claimed that this arrangement keeps the engine supplied with such a hot, dry mixture at all times that there is no appreciable film of unburned gasoline into the crankcase oil, while the elimination of all raw gasoline in the cylinders eliminates the formation of carbon.

Straitening Radiator Fins

ATOMOBILISTS may now provide **A** themselves with a device for easily straightening bent radiator fins and which can be used on any flat fin radiator. The tool consists of three metal teeth held together by a metal handle and in use the teeth are inserted between the fins and twisted from side to side.

Glass for Footbells

A NEW kind of glass, which, if not actually unbreakable, is so tough that it has been blown into a hollow sphere and kicked about as a football without breaking, has been discovered by Dr. Horak, a Czech engineer and inventor. When used in the form of tumblers the glass has successfully withstood the splashing of cold water immediately after being heated to a point where pieces of paper in the tumbler were charred. While the inventor does not claim that he has found the secret of unbreakable glass, he does believe he has found a way to make it possess the greatest resisting power of any glass so far known. It is admirably suited to the making of thermos bottles, which, in so many cases have been too fragile.

Plans have been made for applying it to gas masks in order to provide bullet protection to the eyes of the wearer, although it will, of course, find its principal use in more ordinary directions, such as for tableware, bottles, etc.

A Pipe in the Guise of a Cigar

THE smoker who prefers a good old pipe to any other form of smoker, but who has an uneasy feeling that it isn't respectable, will perhaps be more at ease with the smoke which we illustrate. This is a pipe, made in the form of a cigar. It comes apart in the middle, and the further end is hollow. This is filled with tobacco, lighted, replaced, and the smoker draws on the assembled apparatus just as he would on a cigar. There is an air vent at the tip to permit this, and if he has been so fortunate as not to have the tobacco go out during the assembling of the "pipe," he may have a smoke in the external dress of a cigar, but possessing all the other characteristics of a pipe.

The Hard-Holed Hat

COAL trimmers, perhaps, are more exposed than any other workers to the danger of having heavy objects fall upon them from above. But in a large variety of trades this risk is present to greater or less extent. An unusually successful effort to achieve protection from this sort of thing is represented by the "hard-holed" hat illustrated. This hat is made of the best grade fiber, in numerous pieces, pressed and cemented together by a patented process. The crown is given a tall shape in order to stand great weight, and when advisable is further reinforced with a steel plate. The entire hat is then covered with the best wash and treated with a patented preparation making it water and self-



Simple tool for straightening bent radiator fins

proof, fire-resistant, non-conductive of electricity, and long-wearing. The lining of the hat is "hammoosed" on the head so that it gives perfect comfort to the wearer at the same time preventing the hat from being crumpled down over eyes or ears in case of an unusually heavy blow. The hat itself is pliable and will fit a head of any shape. It weighs from five to seven and a half ounces, depending upon the style, and is comfortable to wear under all conditions.

Perhaps the severest test to which it has been put in use came through the use of a mine engineer who was struck on the head by a weight of 32 pounds falling 15 feet. Though he was brought to his knees by the blow and the hat dented, his head was not in the least injured.



Hardness tester for rapid and serviceable work in the shop

A New Instrument For Testing Hardness

THOUGH who have to do with the manufacture of metal parts, especially metal cutting tools and components of light machinery, know how important is the securing of a definite degree of hardness in the material according to its use. One of the disadvantages of the Brinell instrument is the lack of uniformity and its unsuitability for dealing with thin and fragile articles. The instrument under review has been designed with a view to overcoming these and other shortcomings of the better known hardness testers.

The tester is designed as a pendulum oscillating about its central position. The ball which is of rug or steel is one millimeter in diameter and is held in a chuck in the center of the instrument. Six screened weights enable the position of the center of gravity of the instrument to be adjusted to coincide with the center of the millimeter ball. The graduated weight seen in the center can be raised or lowered, enabling the center of gravity of the whole to be brought to a definite distance above or below the center of the ball, the exact distance being shown on a scale. This distance quadrates the pendulum length which for standard tests is one-tenth of a millimeter. With this length a single swing on a very hard surface has a duration of 10 seconds.

It will be observed that at the top of the frame there is a bubble and scale having set up the instrument on the part to be tested it is tilted (to the right) so as to bring the bubble to zero on the scale. On release it will swing back, then to and fro till the energy is expended and it comes to rest. The harder the material the longer will it take to come to rest and incidentally the greater will be the first oscillation. This action enables the hardness of the specimen to be ascertained either



Safety hat for those who work in danger from dropping objects



The latest wrinkle in pre-heating and general aid to the carburetor



Applying the automatic windshield cleaner to the trolley

from the magnitude of the first swing or from the duration of a definite number of swings.

In the scale test, the amplitude of the first oscillation may be read off on the scale and the position of the bubble denoting the work done by the ball on the specimen, is a direct indication of its hardness. For instance, 97 is glass hard, hard steel reads 88, brass 14 and lead 0. The effect of tilting the instrument is to elongate the indentation made by the ball when it is placed on the specimen and the distance it rolls back along the groove so formed is indicated by the scale from which the hardness is deduced.

A fine time is more usual for it gives uniform and concordant results without the necessity of accurate leveling or extreme smoothness of surface. It is values "time hardness number," which is the time in seconds (stop watch essential) taken in making ten single swings. For material glass-hard the time is 100 seconds, soft steel 20 to 40 and so on down to lead 8.

To take this test the instrument is set upon the specimen with the bubble near the center, or graduation 50, and caused to oscillate through a small arc and the resulting time taken as before stated. The time of the oscillations is, within limits independent of the magnitude thereof.

The overall size of the instrument is 12 inches and the weight eight two or thirteen kilograms. The former has a ruby ball and is used for delicate work, the latter with a steel ball is used for general workshop purposes. The span for clear working is six inches. Articles of an upward shape can be supported in a ball vice, while flat specimens are simply dealt with on the leveling table of the apparatus.



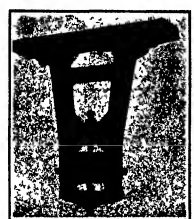
The device that whistles a warning of "low gas"

Clear Vision Ahead for the Motorist

AUTOMATIC windshield cleaners were a first device for use on automobiles, the drivers of which must be able to see where they are going. Vehicles that run on tracks can be run in comparative safety, even when the man in control cannot see where he is going, but when it comes to travelers operated in busy thoroughfares, it is necessary for the safety of others that he see when it is proper for him to go there. The Cleveland Street Railway Company was the first traction interest to adopt the window cleaner. Illustrated, giving the motorist a clear view of the road ahead of the car no matter what the weather conditions. As the photograph indicates, a small electric motor is provided, which keeps the wiping element in constant motion, requiring no further attention from the motorist than the initial throwing of a switch.

For Hanging Shafts

RECENTLY there has come on the market a pressed steel shafting hanger of very pleasing line and good engineering construction. It is of the four-point set screw type, and has a casting yoke which readily permits the removal of shaft or bearings. The main frame is of two stampings placed face to face, with a slotted central web, the entire length of the leg. These flanges provide unusual strength and rigidity, and the design is very good, with smooth frame and rounded surfaces that eliminate dirt pockets and projecting parts.



An interesting shaft-hanger of pressed steel

An Audible Gas Signal

WHEN more than one described the device intended to remind the forgetful motorist that his gasoline supply is approaching extinction. The latest type of the sort actually shouts the warning at him. It is of the general type, already noted, having a long and a short upright tube in the bottom of the tank, with gas flowing normally out of the long tube, until the level of the liquid falls to a point such that it can flow out of the short one. But it departs from the usual standard of this type, both in arrangement and in mode of operation. The principal point of difference lies in the fact that the long tube is inverted at a point where there is suction on the long tube, even after gas ceases to flow through it, and this suction comes to a whistle. As when his car begins to whistle at him, the assembled motorist looks for the familiar bit of red or orange at the roadside that in motoring code means "Gas sold here."

An Efficient Scarifier

AMONG the season's novelties is a new piece of paving equipment put out by a prominent Cleveland concern that specializes in apparatus for the road contractor. As illustrated, it is seen to be, in general terms, a scarifier, but has been found particularly useful in scarifying ground preliminary to mechanical subgrading. It may also be used for all the scarifying found on the average road job, being built very heavy to stand up under such service. Some contractors are using it in place of the rooster plow, and it is finding a place in the maintenance work of many road departments. It carries five teeth, and equipment furnished with the machine includes two complete sets of these teeth, plus one special maintenance set of teeth for extra heavy work. The machine weighs about 1500 pounds, and is furnished for tractor or team hitch.



Another tool for wrecking roads in preparation for repaving

The Spreading of Liquids

AN interesting paper by W. D. Harrison and A. Peelman on this subject appears in the *Journal of the American Chemical Society* for December, 1922. The spreading of liquids both on other liquids and on solids is discussed, and the relations worked out between the coefficient of spreading and the interfacial and surface tensions. The various terms used in the theoretical discussion are defined, experimental methods are described, and the results of numerous determinations given. These interested will do well to consult the original paper, which is not of such sort as to be effectively abstracted.

A Problem in Thermometry

TEMPERATURE indicated by a thermometer in a medium whose own temperature is changing, presents a hard Mr. S. P. Owen of the University of Michigan has attacked the problem of determining this, by taking into account the effect of the containing vessel. Complete solutions are obtained for spherical and cylindrical bulbs, with surface conductivity both infinite and finite in both cases. The mean has all cases taken the form of a series, of which only the first term has numerical significance.

A Signaling Window for Closed Cars

WHILE the "stop" light is a good thing, it is not yet recognized by law, and it is likely as any other vehicle on the road is to be out of order, the editor drove ten miles, not so long ago, behind a car whose "stop" light was burning continuously. Then, too, no body but the driver of the car blabbed knows whether the "stop" light was burning or not. There is a reason. There is a small cannot usually see it, and the driver of the car could not possibly testify of certain because that his "stop" light was burning. So with all its merits, this device leaves plenty of room for improvement. The improved type of hand signaling.



Novel type of window that makes hand signaling from a closed car easy

A Dubuque inventor, Mr. W. A. Brown, points out that the closed car is still a long way behind its open brother in the degree of freedom with which its driver can signal by hand. It's all very well to signal inside the car and trust to the man behind to see the signal through the rear window, but what when the rear seat is occupied? What, in any event, when the driver behind goes into court and states flatly that he was watching, but saw no hand signal? So the inventor in question has given us a signaling window for closed cars. It opens with a push—a mere touch, in fact, of the hand that moves outward to give the signal, and closes again with a pull on a lever or a cord or a strap—or anything else that the owner prefers, for that matter.

A New Role for the Clutch

CIN its own factory, a Wisconsin concern making disk clutches discovered a new application of their own product. They had to change the location of some of their machines in order to expedite production, and they found the usual difficulties in the installation of countershafts. It was suggested that they install one of their own clutches on each lathe, and drive a battery of shaft lights from one clutchshaft. This was done, eight countershafts and eight cross-belts being discarded, and at the same time the fraying of belt edges by belt slitters being abolished for all time.

It is suggested that this new application of the clutch line will enable every manufacturer to modernize his equipment and cut out his countershaft trouble. The clutch which served so well in the present instance is illustrated. It is a two-disk affair, so designed that the lifting of one pin permits adjustment up to such, no tools being required. It gives a positive engagement and does not heat.



The two-disk clutch that gives positive engagement up to 24 inch diameter



The latest electrical aid for the kitchen—cross whipper

The Electric Cream-Whipper
AMONG the special jobs about a house for which a special machine is now offered is the whipping of the cream for the morning cereal or the evening pudding. The entire apparatus as illustrated, motor and beater, though purchasable separately normally comes in a single unit from the manufacturer, but, of course, the motor is available for other work. The labor of whipping cream is considerable, in unfavorable weather, and even under the best of conditions, it is a little job which the housewife will not do glad to get done for her, mechanically.

Filling the Radiator
WITH the aid of this newly designed patented metal can or bucket, with a wire reinforcement around the top and equipped with two useful handles, the funnel, splash and drip have been eliminated in the filling of radiators. Note particularly the shape of the spout, curved so as to fit in the radiator opening, eliminating splashing and leaking. The outlet opening is large and with full weight of water behind it, these radiator fills are exceptionally quick-emptying. The bucket holds about twice quarts of water.

An Efficient Hand Lifting Appliance
An efficient form of hand lifting-gear has recently been perfected. The hat is adaptable, the absence of a drum rendering it equally suitable for a lift of two feet or 100 feet. It can be used on a job for warehouse and garage work, or can be fitted on board a small craft as a captain for handling persons. The appliance has a capacity of one ton. An internal gear is mounted on an eccentric spindle, to which a handle is bolted. When the handle is revolved the gear is caused to oscillate in such a manner that the teeth of the internal wheel roll round those of a bevel pinion



Substance for lifting jobs, with a wide range of application

mounted in the body of the bevel. The lateral wheel has one tooth more than the fixed pinion and is thus enabled during one oscillation to advance one tooth, while the chain wheel sprocket, being cast integral with it, is revolved and the load raised.

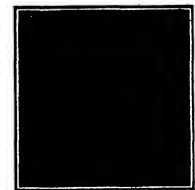
Braking and lowering are controlled by a drum and pawl mechanism, the drum being supported in the front of the frame, in which it is free to revolve, but is held in position by pins.

Directly the handle is released, the pawl engages with the teeth of the drum and tends to rotate it against the pressure transmitted to the drum periphery by the load. This friction is quite sufficient to prevent the handle from revolving of its own accord, but the application of a few pounds pressure is enough to rotate the drum. It will thus be evident that the load cannot overrun when the handle is released during hoisting or lowering.

Drill and Gas Engine in a Single Unit

HERBOTOPE, all power drills, of whatever type, have been limited in their application to the work by the length of an air hose or of an electric wire. Power for either of these methods must be supplied by an auxiliary power equipment which, on account of size and weight, cannot be easily transported, nor located sufficiently near the work to do more than 90 per cent of the drilling, to which a power drill could, if itself, be profitably applied.

A Philadelphia inventor has now marketed a drill driven by a small gasoline engine. It combines the action of an air hammer and gas engine that the entire drilling assembly has but two moving parts—the hammer piston and the fuel-valve member. No crank shaft or connecting rod is employed, and there is no spring or other yielding member. No exhaust or exhaust valves are necessary, the rotary valve principle being used, with the revolving mass of the



Easy filling of the radiator, without splashing, achieved with this specially designed bucket

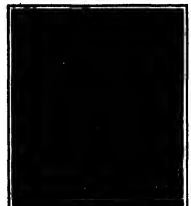
fly wheel opening and closing the ports in the cylinder at the proper moments. The down or power stroke of the hammer piston is made with some 500 pounds of explosive force from the gasoline behind it. The flywheel returns the hammer piston on the upward or compression stroke. Approximately 1900 impacts are struck per minute by this staple-cylindrical bit of humanity. Carburetion is by means of a gasolene-mixing valve which permits the engine to work at any speed. While the engine drill runs at full speed, the operator shifts it from one position to another and to any desired angle without stopping the operation. A single spin of the fly-wheel by hand starts the drill "on demand, in the coldest weather." This looks like one of those things in connection with which the much-bused word "revolutionary" may fairly be used.

Another Phonograph-Record Recorder

THIS latest and most simply constructed recorder for playing phonograph records has been just patented and is now ready for distribution. This device after several experiments, has been proven not only to be practical but to be easily handled by children.

This repeating device for the phonograph needs no adjusting whatever. It just sits in the center of the record over the peg, and does not touch the playing surface nor will it injury in any way the record or the needle. Its action is instantaneous with no break or pause between the end of one run and the commencement of the next.

As the needle at the end of the sound



This portable drill carries its own gas engine, and is tied down by no air hose or current connection

box reaches the end of the record, the tone arm is automatically carried (quick as a flash) and gently placed at the starting point.

This device is made from sheet steel punchings, consisting of flat base plate, a movable arm which picks the tone arm up at the bowtie, operating on a cam, which is automatically returned to its original position by means of a coil spring. It is handy and convenient to apply and to use and its total weight is less than one ounce.

Permanent Automobile License Plates

ANNUALLY in the United States 20,000,000 automobile license plates go into the discard and this means that twenty millions more must be made. The cost of the making is borne, in the last analysis, by the motorist. To obviate this difficulty, James B. Sellers of Los Angeles has designed a plate which will be permanent, so that the motorist will always have the same serial number. When the plate is first stamped it receives three extra impressions, being in the nature of depressions deep enough to counteract even with the surface the additional smaller plates bearing the date which is subject to change at the beginning of each year. The depression at the left of the serial number is dimensioned to match a small plate bearing the name of the State and the year. Above and below the number are smaller depressions for the application of what ever date the owner desires, such as his name and hometown, or his club. If desired, these spaces may be left blank. The smaller plates are attached securely and quietly by means of small screws with nuts.

A Clean-Cut Gas-Tank Filling Plug

THE necessity of a locking plug for the motorcar is an admission that there are few things connected with the automobile, whether valuable or of small



The newest phonograph recorder

value, that are not the object of petty theft. Even gasoline is siphoned from the tank and the unsuspecting motorist, returning at night, is faced with the unpleasant discovery that his tank, which he thought was simply full, has run dry. As gasoline is not a particularly valuable commodity, the addition of a lock to the filler pipe acts in practically all cases as sufficient deterrent to end the thief to the next unguarded car for his pitifrage. In the case of patents granted to R. B. Solles of Savannah, Ga., this lock takes on a particularly neat as well as efficient form. The lock, which is of the type having a fitted key is entirely contained within the removable plug and the actual locking member or lug is placed in the plug in such a way that it is as inaccessible for tampering as is a similar type of lock when mounted on a metal door. When the key is inserted and turned the plug, which includes the lock mechanism, is remarkably small space, is removed. There is no other handle for this purpose than the inverted key so that when the filler has been completed the plug reinserted and the key removed, the lock is flush with the surface of the tank, leaving no projections for prying. At the bottom of the filling member, which is tapered and about four inches in depth is placed a coarse grating which prevents any particles of matter from getting into the tank when it is open for filling.

Window Washing From Within

A SEAT for which many housekeepers will not accept even a free ticket is that upon an upstairs window ledge. Fear of falling makes the prospect of cleaning the pork marks of dust and dirt, spotted by rain, from the outside of the bedroom window pane. If the housewife will invest in a "third seat," however, the cleaning can be done from within the house. A long handle has at its end an elastic turned at right angles and about four inches in length. The "fore arm" is the "hand," which grips a wet cloth, chambray, sponge or rubber. After the window cloth is latched to this over-ready model



Cleaning the outside of those upstairs windows, without sitting out on the ledge



The "B" battery that stands up instead of lying down, thereby saving much space

servant, for the task of polishing the pane. Nor is this the only unpleasant house-cleaning job that the "third arm" will do. When the non-cotton window blind "show-up" the dust and grime upon the wall paper a clean cloth can be used in the same tool for wiping down the walls.

Gaskets for the Piston

YOU have gaskets in numerous places about your car where oil or oil pressure might leak out in their absence. You have packing in your pump and valves here and there and every where else, but your piston rings are left to make a tight fit as best they can, without any external aid. In the car of the future it may be different, we have seen at least two proposals to make it so. One of them consists in a cork-lined piston ring, the cork lining performing approximately the service of a gasket. This manufacturer makes you buy the rings to get the gaskets, but another is more liberal, and sells asbestos piston seals alone, to be fitted to whatever rings you happen to have on your pistons. The latter is made in both cases that gasoline leaks and all pumping are much more effectively checked than by plain rings of any design, and that carbon is thereby reduced and power increased. We tried the cork specimens in the editorial THE LATEST, and found that at least, they gave no bad effects whatever, on the extent of their good effects we were not certain, since the car was in admirable condition when they went on it.



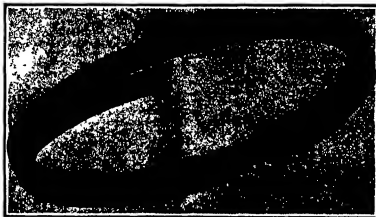
The machine that balances moving parts at production speed

A "B" Battery That Takes Up Less Space

ENTHUSIASTIC!—this is the word employed by the makers of a new and larger type of "B" battery, to describe the record given the article by the radio audience. The new battery may be called a vertical battery, standing on end and having its terminals on top just like the regulation dry battery. It is four inches by three in cross-section, 4 1/2 inches high, and occupies less than half the ground space taken by the usual "B" battery of equal capacity. Its voltage is 22.5. It includes in its construction the features of seamless drawn wire case, individual cell insulation, thorough moisture-proofing and improved series connections. Its successful advantages are particularly noticeable when a number of units are bound together in compact sets with dry "A" batteries, and used with portable sets. Also for loud-speakers, where four or more "B" batteries are used in series to produce a high potential, the new battery is extremely convenient.

A Precision Balancing Machine

THE illustration shows a balancing machine recently placed on the market, applying the principles of dynamic and static balancing invented by Dr. B. L. Newkirk of Schenectady, so that it is possible to obtain complete dynamic



Asbestos or cork linings for piston rings are claimed to cure many of the current automobile malaises

and static balancing of two single corrections, individually measured and located near the ends of the body. When duplicate parts are to be balanced in production, great rapidly can be attained as static balancing is rendered unnecessary and the operator, who need not be highly skilled, has only a few simplified positive steps to perform.

A spring-mounted and pivoted frame



A very handy tire pump operating from the engine through a rear-wheel hub

carries a special type of headstock and adjustable rollers to support the work. By the form and location of the springs, a free vertical vibration of the frame may take place about the pivot springs as a fulcrum point. All revolving parts, including the rollers which support the work are mounted on ball bearings. A speed of rotation above the "critical speed" of the frame is first used, and the driving power is then disengaged, permitting a gradual diminution of speed down to and through the free

The pump itself is clamped to the running board. The arm leading from the pump to the hub is adjustable to meet the differences in running board design, the short arm that forms the driving connection has to be supplied in size and shape fitting the hub of the given car. The pump can be used on 80 per cent of the automobiles now in use. It is clamped to the hub of one of the rear wheels and then this rear wheel is jacked up and the engine started.

Accurate Tire Inflation

A NEW tire inflating device resembles the signal apparatus on the bridge of a ship. On top of a metal standard there is an air gauge 6 1/2 inches in diameter, equipped with an indicator attached to a metal handle. By means of the handle, the indicator is placed at the number of pounds inflation desired by the motorist, in the same manner that signals are given to the engine room from a ship's bridge. As soon as the indicator is placed at any inflation point, the air is released into the tire. When the desired pressure has been attained, the air is automatically cut off from the tire valve.

The air inflator consists of a reducing air valve working in conjunction with an air gauge. The indicator may be set for any pressure, from that required by a bicycle to that of a truck tire. It registers the pressure from the time the hose is applied to full inflation, eliminating the necessity of one or several tests with a small hand gauge.



When set to the desired pressure, this inflator raises the pressure of air as soon as that figure is reached in the tire

critical speed of the frame. From the observation on the dial indicator mounted part way up on the column at the left, the amount of the required correction is determined.

A disk at the left of the revolving parts carries a standardized 10-ounce weight, adjustable radially by means of a vernier reading to 0.01 inch. These parts are exactly balanced when the weight is at zero. The disk is adjustable to any angle by reference to a protector dial.

With the correction thus arbitrarily applied the machine is again speeded up and allowed to pass through the critical speed as before. The second amplitude in this process bears a relation to the first amplitude dependent on the angle between the point of application and the point required. After determining and setting off this angle, a third run will check the result. The machine is universally adapted to a wide variety of work, including balancing crank-shafts, flywheels, rotors, pulleys, and other revolving parts. It will receive bodies up to 24 inches in swing and 22 inches between bearings.

Pump Operated From Rear-Wheel Hub

THIS novel tire pump is operated from the hub of the rear wheel and can pump up a tire in a few minutes.

The Service of the Chemist

A Department Devoted to Progress and Achievement in the Field of Applied Chemistry

Conducted by HENRY DIMARCO, Chemical Engineer

New Source of Nitrates in South Africa

ACCORDING to the South African Journal of Industries, a new source of nitrates has been located on the Matopos Pan, situated in the Hageroof of the Transvaal. This Pan is remarkable in that it contains a kind of an underground store of nitrate-bearing brine. Analyses of the brine from several boroholes showed that over 4.5 tons of natural nitrate, mostly sodium nitrate, are to be found in every 20,000 gallons of brine.

Catalysts in Glass Making

FLUORINE and antimony have the curious property of altering the thermal expansion of glasses to which they are added. They appear to act in a catalytic manner so no fluorine remains in the finished glass, and about 1 per cent of antimony may remain. It appears to be held physically rather than chemically. It is withdrawn from the glass during working, and is washed out by its boiling water and even more so by sodium tartrate and hydrochloric acid.—*Chemist-Zeitung*, 1923, page 148.

New Alloy for Grate Bars

THE burning out of grate bars in the industrial boiler as well as in the domestic steam heating furnace, is a rather common occurrence. In a firing furnace with mechanical stokers this has been a source of serious losses. A new alloy, a nickel-chromium-iron cast iron, has been devised which appears to overcome most of the difficulties. The new alloy is a special form of purified cast iron with a much higher melting point and tensile strength. Its life is claimed to be from three to ten times that of ordinary cast iron and it pours without difficulty and does not crack. The cost is only 50 per cent higher than that of ordinary cast iron.—*Iron Age*, Chem. Ed., 1923, page 375.

Paper from Banana Refuse

A banana refuse, according to the World's Paper Trade Review, The trash or refuse, consisting of the stems and leaves of banana trees, has been used in fruit has been cut, is passed through crushing rolls, which produce a mash in which the moisture has been reduced from 90 to 50-75 per cent. The liquid is drained off and the trash is passed through a breaking or pulping machine where it is reduced to a pulp. The pulp and juice from the machine are then placed in a boiler, water is added and the mixture is boiled at a pressure of four to five atmospheres for a period of three to six hours. The contents of the boiler are then transferred to a beater, where the rotten and gummy materials, which have been set free during the process of boiling, are washed away as powder or pellets by a current of water. The removal of the fibrous material from the beater completes the process, in which the chemical is used.

Building Paper for Building Purposes

A NOTHER use for waste liquor recovered from nitrate oil-soluble nitrate has been developed as described in the German Journal, *Chemische Industrie*, 1923, No. 28. Lean, as sandy as possible, is mixed with about 5 per cent of

hydrated lime and about 2 per cent of the waste liquor is added. About 5 per cent of technical hydrochloric acid is added to the mixture. In this manner there is formed a large quantity of hydrochloric-sulfuric acid that a solid, absolutely water-resistant mass is produced. When the process is allowed in certain respects a product is obtained which may be used to good advantage as a substitute for tar roofing. This product is now lasting than the ordinary tar roofing and furthermore it does not possess the well-known advantages of the latter. By using this material the build may be finished off both inside and outside with the same building material and consequently the labor involved in using plaster and similar finishing materials is considerably reduced. Sulfite cellulosic waste liquor can also be used to good advantage in manufacturing in suitings slacks and plates, flower pots, as well as many articles made heretofore from hard rubber.

War Gases Cure Disease

THE Chemical Warfare Service of the United States Army has been conducting tests at the Edgewood Arsenal to determine the specific effects of war gases, originally intended to kill, to cure disease. The gases have been found to be effective in the treatment of influenza, tuberculosis, pneumonia and other diseases. Weak concentrations of chlorine gas, when inhaled, do not appear to be harmful to the human body. In fact, they have been used to prevent the spread of grip and in influenza epidemics. Mustard gas has been demonstrated as a specific against tuberculosis. Tests have been made with guinea pigs inoculated with tuberculous germs and a concentration of mustard gas, and it was found that the animals did not contract the disease. The substance lewisite was experimented with and it was found that this is a remedy if not a cure for paratyphoid and typhoid. During the war the fact that chlorine could be used to prevent or cure colds or pneumonia was accidentally discovered at the Edgewood Arsenal. It was remarked that cases of pneumonia, influenza, etc., did not occur in the laboratory where chlorine was being used, although 40 to 50 per cent of others on duty at the arsenal were victims. Investigation showed that in the rooms where chlorine was being used there was a slight leakage of chlorine, just enough to act as a germicide agent.

Double Window Panes

OUTLINE window panes, separated by a distance of two millimeters and joined together by a specially designed and patented melting process, so that no moisture or dust can penetrate between them, are now to keep the cold in the place of ordinary window panes according to a Swedish process. The best insulation is perfect under these conditions.

New Alloys

NEW alloys, which are especially well suited for making projectile shells, are described in the German Journal *Chemische Industrie*, 1923, No. 5, page 36. These alloys are made by adding bromine or vanadium brass with copper, aluminum and nickel or with copper, aluminum

and iron, or with copper, aluminum and manganese. Vanadium appears to combine more easily with iron, nickel or manganese than directly with copper or zinc, so that iron, nickel and manganese are first dissolved in concentrated nitric acid. Vanadium can also be added to the metallic composition in the form of ferro-vanadium. When this is done, the cost of the alloy is reduced.

Volcanic, a Substitute for the Industrial Diamond

THE industrial diamond, the black l'ort, is replaced to good advantage by the cheaper volcanite, according to a report of the Prussian Geological Institute. While the product volcanite is not of maximum hardness, nevertheless it has been reported that it gives absolutely satisfactory results for boring rock of medium hardness. The reader is referred to the original article for further information.

Tallow Green

IN Texas there is being grown a tree which is called tree to the United States. This is the Japanese tallow tree. Trees of this species of tree nuts contain a rich tallow like oil. This oil has been found valuable in the manufacture of hydrocarbon varnishes. It has been found that the climatic and soil conditions are well adapted to the growth of this tree in certain parts of Texas.

New Rust-Preventive Agent

ACCORDING to the *Iron Age* in Tech, a new rust-preventive agent, a part of the *Technical Zeitsung*, February 28, 1923, a new rust-preventive agent or rather process has been developed which is particularly useful in protecting vehicles and vessels. The process consists in producing a coat of protective condition on the metal. This film of condition has a thickness of from 0.002 to 0.001 of an millimeter and is produced in the electrolytic way by dipping the metal into a solution of a cadmium salt. The coated metal part is then placed in an annealing furnace where it is heated to a glowing heat for a period of two to three hours and in this way the deposited film is made solid with the underlying metal. The surface coating that is produced in this manner is much more durable than the ordinary oil-soluble products for galvanizing with alcohol. The color of the treated part resembles that of a silver-plated article.

Blotting Paper from Wood Pulp

A LOTTING paper is generally made from rag pulp, and it is accordingly a really important achievement that has been recorded in the daily papers that a Canadian pulp mill has succeeded in manufacturing a very good grade of blotting paper from ordinary wood pulp. Blotting paper made in this manner costs considerably less than the other kind.

Differentiating Hemp from Flax

FLAX is one of those products that is subject to a great deal of adulteration, so that it is difficult to tell if it is really flax and its price is high. One of the substances used in adulterating flax is hemp. The hemp process has been causing considerable trouble, due to the difficulty of differentiating between the two fibers.

Cotton is also used to adulterate flax, but it is a comparatively easy matter to distinguish between flax and cotton mixed with the flax fiber under the microscope.

The Lihen Research Institute of Ragned has devised a simple test whereby it is a comparatively easy matter to distinguish between flax and cotton. The hemp fiber. Considerable ultraviolet work was done and it was determined therefrom that the hemp fiber is developed upon a right handed spiral and the flax or linen fiber is a left handed spiral. If a thread is traced out and wetted it will tend to curl up either in the same direction as the handle of a clock or in the opposite direction. If the thread is bent, or against the clock if it is flax. If both motions are found in the same direction, the so-called linen is bound to be a mixture.

Making Linen Bags More Durable

LYNN BAGS, especially those that are used for shipping fertilizers, are rendered more durable by dipping them into a solution of potassium silicate or sodium silicate (water glass). They are then sun-dried and dried. The solution of the chemicals must be rather dilute. For further details, see the reports of the Académie d'Agriculture of Paris.

New Mercury Deposit

A NEW vein of quicksilver said to be a seven mile long vein, was discovered near Kila Ontario in the Ooto Archipelago. The ore contains 18 per cent mercury, and preliminary trials indicate that the vein increases in thickness as the depth increases. This vein is important as none of the veins so far discovered in Japan are suitable for working.—*United States Commerce Reports*, Feb. 12, 1923.

Lignite Char

THE United States Bureau of Mines has made an extensive investigation into the possibilities of using lignite as a fuel. As is well known, there are very large deposits of lignite coal in the states of Pennsylvania, Maryland, West Virginia, and Illinois. These deposits are not being worked at the present time, but they are of great importance. Lignite will sooner or later have to be resorted to as an oil because warner. The Government has realized the possibilities of lignite coal, and experiments have been made to convert it into such form that it can be utilized as a general fuel.

The great trouble with lignite is that the coal contains a large amount of moisture and in an apparent case of ash. The fusion temperature of the ash is comparatively low, which makes high rates of evaporation difficult and requires larger grate areas and furnace volumes than with higher grade coals. In other words, the coal has to be improved first before it is possible to use it in the ordinary power plant.

The lignite is accordingly charred. The moisture and volatile matter are driven off and a solid appearance which requires less anthracite coal except that it is softer and contains a little more volatile matter. This makes it more difficult to handle. About 2.5 tons of very lignite coal will produce one ton of char, which has a heating value of approximately 25,000 B.T.U. It is a very good fuel. The moisture is very low, and the char can be stored without any danger of fire or degradation in ash.

The Motor-Driven Commercial Vehicle

Continued by MAJOR VICTOR W. PAGE, M.E.A.E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles.

A New Motor Pick-Up Street Sweeper

IN perfecting the present mechanically successful sweeper, the designers managed to surmount many obstacles, which formerly hampered economic operation. These mechanical difficulties consist in this type of sweeping conveyor have not only been removed but a greater amount of working dependability has been incorporated.

A noteworthy improvement in this sweeper is the automatic gutter broom that works in and out with the curb line, independently of the driver. The earlier types of sweeper did not have this provision for cleaning gutters with the result that additional men were required to complete regular cleaning equipment. Today with increased traffic pushing more refuse from the center of the street toward the gutters a greater need was created for a special attachment for cleaning the gutter. The gutter broom attachment was developed to take care of this need. It not only cleans the gutters more efficiently but with a great saving of labor cost as well.

The design of the large rear broom is such that wear automatically shortens the distance between the broom and conveyor. Fanning of the conveyor through breakage of the shear pins is prevented by the broom's coming to complete stop. The conveyor is of large capacity and of the non-clogging type. Heavy sweepings are allowed to choke the conveyor. The renewable bottom, in itself a feature, is easily replaced. Only six drive chains are employed on the entire machine, including the conveyor. The sweeper can be operated while the machine is at a standstill. Mechanical parts are readily accessible. The working speed is nine miles per hour.

The new sweeper is of the four-wheel type and employs a speed wagon power plant of standard construction with right-hand drive and self-steerer. It is a one-man machine with the operator arranged that the operator has complete and convenient control without leaving his seat. The rear axle is mounted on a swivel and is moved forward and converted into a jack shaft, whence the drive is through roller chains to each rear wheel. An auxiliary transmission is mounted between the transmission and differential to give power to the operating conveyor, large broom, gutter broom and water pump. The large broom, of steel

or bamboo, is driven by a roller chain on cut steel sprockets. This rear broom is quickly adjusted to the roads and is automatic in operation after adjustment, following the pavement with just enough pressure to do good work.

The conveyor is driven by roller chain on cut steel sprockets. The conveyor itself is of all-steel construction with renewable bottom. Rubber scrapers mounted on extra carbon steel angles form the flights. An efficient anti-clogging device takes all undue strain off the conveying mechanism and allows piled material to be swept without clogging the conveyor. The hopper or dirt receptacle is also of all-steel construction. The gutter broom is driven through a universal joint assembly from auxiliary transmission. The broom is steel fiber filling, built up to 42 inches diameter in six sections that are easily and quickly changed when broom is worn out. The working range is seven feet.

The water sprinkling system consists of a 10-gallon activated iron tank with brass strainers at intake and outlet. Water runs by gravity to rotary gear pumping brass pump which forces water to brass nozzles mounted under the bumper in front. The water spray is controlled by the driver.



Motor truck touring home in camp for the night and on the road. Note the compact method of stowing the load.

New Supply Trucks for New York City Department

THEIR new construction gasoline and oil supply tank trucks have recently been placed in service by the New York City Fire Department. These are four-wheel-drive chassis. They are the type having traction on all wheels, but steer only with the front wheels, and are the first of their kind to be purchased by the city of New York. These trucks are equipped with 300-gallon tanks with three compartments of 300 gallons capacity each. In addition, they carry



Gasoline supply motor trucks now being used by the New York Fire Department. These trucks are of the four-wheel drive type.

four 5-gallon cans in the filler box, six 5-gallon motor pumps and four 5-gallon oil cans with top stops—ample for the service they give.

It is intended that the trucks shall carry oil in one of the 300-gallon compartments and gasoline in the other two. They will carry 100 gallons of fuel and lubricants to the various stations of the New York City Fire Department, supply the needs for the operation of motor-driven apparatus, and should be of special value in the winter.

comfortable and roomy as those at home, and a number of protective appliances. Incident weather are features that will make it a treat to travel in this latest type of home on wheels. Bodies of aluminum alloy varying in length from 11 feet 8 inches to 10 feet 5 inches and in height from 66 inches (standard) up to 78 inches with standard width of five feet are available. Two to four passengers can comfortably travel in the smaller unit medium sizes and two to six in the larger vehicles.

"Just how do you" someone may impatiently ask at this point. Really, it is a simple matter. It is the right in the rear is a little less, on top of this is a three-quarter motor. Other vehicles contain problems and take more packed in such a way that there is no noise.

"Where do we sleep?" is naturally the next question for the traveler to ask. It's an easy job to arrange sleeping quarters. First the seats, which are collapsible, are put out of the way. Then the bed at the left side with fall springs is let down and opened up the full width of the body. When in use, this bed with pillows and blankets is provided by a canvas cover. Another bed with a water-proof canvas cover is placed at the rear and held two feet above the ground by means of chains based on the top of the body. When not in use, this bed is fastened against the rear of the body and is covered by a dust and waterproof canvas.

The bed in the rear is completely covered and is obtained in a double tent canvas the top of the body, which in the daytime may be used as a protection from the sun when passengers wish to eat outside. Fixable windows are provided in these curtains. When it is desired to eat outside, the canvas down which forms the table inside can be removed stowed together, and mounted on collapsible legs.

There are twelve for camping—tools—all the tools are provided—convenient racks for bottles, a canvas water bottle which keeps the water sweet by exposure, toilet facilities, electric lights in fact, everything one has in the home. Everything is packed inside on the small space, and everything one could desire is in place. It is a few minutes, one can make camp or on the road to the next stop miles away—wherever and whenever the whims of the party decide. The enthusiastic motor traveler in truth, can go as far as he likes and come back whenever. It places in this facility, convenient touring home

motor truck touring home in camp for the night and on the road. Note the compact method of stowing the load.

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The mechanical street-sweeper is self-propelled and has a gutter broom working in conjunction with the permanent broom

The Cathode-Ray Oscillograph

Measuring Electric or Magnetic Forces by Their Effect Upon a Stream of Electrons

By J. B. Johnson

Of the Bell System Research Laboratories, Western Electric Co.

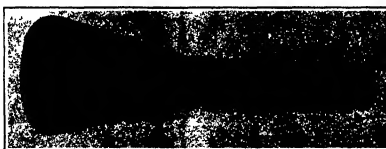
IF THE stream of bullets from a machine gun pass through a stiff square of wire, they will strike the target at one side of the bullet's eye, and this deflection will be a measure of the force of the wind. In much the same way the stream of tiny electrons shot from the hot filament of a vacuum tube can be deflected by electric or magnetic forces, and if a target is put at the end of the tube, the amount of the force can be measured from the deflection it produces.

This in brief is the fundamental principle of the cathode-ray oscillograph. Invented about 25 years ago by Braun, and known by his name. In Braun's tube the electrons were started by a high voltage between the spiral terminals which were sealed into the glass tube, which was then exhausted of nearly all the air. Some of the electrons went through the hole in the plate in a tiny stream, while others struck the target. The hole was coated with substances which glowed when struck by the electrons, so that a spot of light indicated the end of the stream. If an electric voltage was applied between the plates, the stream would be deflected toward the positive plate, and the spot would move across the screen.

The Braun tube had two limitations—the air left in it was gradually used up and had to be renewed, and the voltage required was from 10,000 to 50,000 volts direct current. This was not only expensive and hard to handle, but dangerous to the operator. Hence the Braun tube never was used as much as its other good points deserved.

With the development of the modern vacuum tube, however, a way was opened to get the desired stream of electrons more easily, since electrons are given off a heated filament at moderate voltages. In the drawing, *F* is the filament heated by a six volt battery. Another battery usually of small dry cells like the familiar radio "D" batteries, provides 300 volts between the filament and the other electrode *A*. This voltage draws off two charged electrons from the filament, which pass through the little hole in the plate *P*. The electrode *A* is in the form of a little tube, down which the electron pass. From its end they come out between the pair of plates *P*, and down the vacuum space until they strike the target *T*. (For simplicity only one of the two pairs of plates shown in the photographs is mentioned here. The second pair is at right angles to the first and is used to move the beam at right angles to the motion produced by the first pair.) One plate of the pair *P* has a lead which comes through the glass to a terminal and the other plate is connected to the electrode *A*, and so to a terminal outside the tube. Thus a voltage can be put across the two plates *P* and the stream of negative electrons will be drawn toward whichever plate is positive. The movement of the spot of light which shows the end of the stream on the target is thus a measure of the force exerted on the stream at the plates, and so of the voltage applied to them. Since the stream of electrons has practically no weight, a change in the applied voltage is reflected instantly in a movement of the spot. This instantaneous feature is what makes the device so useful, because the spot will faithfully follow alternations of the voltage up to a million cycles per second or even more.

When the thing to be measured is a current rather than a voltage, two small coils of a few turns of wire are placed on opposite sides of the tube. The magnetic effect of the current will deflect the stream in a direction parallel to the plane of the



Overall view of the tube used in the cathode-ray oscillograph

coils, and the luminous spot will move just as before. In the development of this device one difficulty was overcome in a way which gives an interesting illustration of what happens when electricity flows through a vacuum. The stream of electrons which shoots out from the tube is a stream of machine gun bullets, each of which flow independently of all the others. It resembles more a stream of water from a nozzle, the individual droplets of which tend to fly apart. The repulsion between electrons makes the

In the straight path, in spite of the repulsion between electrons which tempts them to spread out. Further, the dissipated electrons shooting off in all directions near the end of the stream with positive charges, which repel the flying electrons and make them keep in their own path.

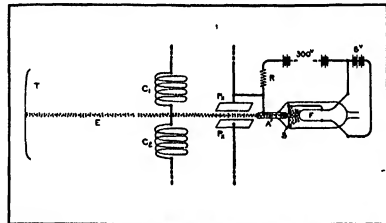
The usefulness of this tube oscillograph comes from the fact that the stream of electron forms a nearly weightless pointer whose movement will accurately follow the changing conditions in the circuit to which it is connected. In order to be able to follow the magnitude of separate swings it is necessary to draw the beam back and forth across the target so that the path of the spot during consecutive swings is a series of small loops, which do not overlap. Up to a few hundred cycles per second this can be done by waving a bar magnet back and forth near the tube. Since the electron stream is really a current of electricity, it is deflected by magnetic field just like the wire carries a current. If it is necessary to repeat the pattern, the sideways motion can be made uniform by rotating near the tube a coil carrying a constant current.

In most cases, however, what is wanted is the variation of a high-frequency current not with time, but as some other quantity is varied. For instance in radio-telephony it is often desired to know the variation of the radio-frequency modulated current with the voice-frequency input to the modulating tube. This relation is of unusual importance as it indicates whether the outgoing waves will set up an undistorted signal in the receiving station. In this case the electrons are so connected to the two sets of deflector plates that while the radio current rises and falls, the audio input moves it sideways. According to the theory of modulation, the amount of radio current should vary uniformly from zero to a maximum as the voice current moves from one extreme of its cycle to the other.

The chief value of this cathode-ray oscillograph is that it makes it possible to see what is going on in an electric circuit. Thus it can be used rather to explore a situation and find out roughly what is going on, as a first step to devising measurements which will be more accurate. For example, after the apparatus is set up, the horizontal loops can be taken very rapidly on one sample after another, as pointed out a day or so by the more accurate "post-by-polar" method. Also for demonstrations before classes up to about 50 persons, this device is what is having with a clearness that is most convincing.

The Most Famous Text in the World

THE TEXANOS 2600 G. will never wear out. It is not a suffer a collision, for it has been selected to represent the "text" of the "Mars" and has been placed in a position of honor in the heavens. The ceremonies of installation were most impressive, but the shining orb failed for the first time to create for three, for they were witnessed "in formation" at the great parade ground.



The electrical principles involved; for reference, see the fourth paragraph of the text

stream spread out so that it will not give a sharp spot on the target. The remedy was developed by our engineers, who during their experiments used a tube containing a small amount of gas. Now every gas is made up of separate molecules, each of which has a comparatively large central nucleus, positively charged with electricity, and surrounded with a number of more tiny charged electrons held to it by electric attraction. The free electrons shoot down the tube at a velocity of about 6000 miles per second, and while one of them

torced out, the other is left behind. This relation is of unusual importance as it indicates whether the outgoing waves will set up an undistorted signal in the receiving station. In this case the electrons are so connected to the two sets of deflector plates that while the radio current rises and falls, the audio input moves it sideways. According to the theory of modulation, the amount of radio current should vary uniformly from zero to a maximum as the voice current moves from one extreme of its cycle to the other.



The cathode-ray oscillograph set up in the laboratory, ready for use

Recently Patented Inventions

Brief Descriptions of Newly Invented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Chemical Processes

AROMATIC HYDROCARBON CEMENT—W. R. BARNES and L. GLAWKIN, inventors, via Newville, Queensland, Australia. This aromatic cement, which may be used for building purposes, is generally a chemically prepared compound as follows: Toluol, tar or any other substance which contains principally of aromatic hydrocarbons matter of an aggregate specific gravity of not less than 1.00 degree Centigrade to a temperature of 120 degree Centigrade to 180 degree Centigrade at the time thoroughly heated is added in powdered form a sulfates salt with the tarry material in a fluid condition.

METHOD AND APPARATUS FOR PRODUCING A CHEMICAL UNION BETWEEN HYDROCARBON (GASES AND HYDROCARBON OILS)—H. H. SYKES, Box 48, Hirstown, Texas. The object of this invention is to provide an apparatus by which a complete union between natural or methane gas, CH_4 , and heavy hydrocarbons, such as C_2H_6 , may be had, and thereby producing hydrocarbon compounds, such as C_3H_8 , or other hydrocarbon compounds. The method consists in subjecting a volume of methane gas to a high degree of compression, then introducing a quantity of hydrocarbon oil, and passing an electrical arc through the gas and oil while in its compressed state.

PROCESS OF TREATING VEGETABLE FIBER—H. C. FOWLER, 2001 Chestnut St., N. B. Pittsburgh, Pa. The invention has for its object to provide a process for preparing Florida or Spanish moss for use as a stuffing for mattresses and the like. The process consists in the removal of the plant juices from the fiber, the drying of the fiber and its conversion into a softening and plumping the same, the removal of the plant juices consisting in subjecting the fiber to acid and alkaline baths.

Electrical Devices

SWITCH—O. C. WENGER, 18 Logan St., Brooklyn, N. Y. The invention contemplates for one of its principal objects the provision of a double switch provided with means which render the same capable of either mechanical or electrical activation. A further object is to provide a switch which is simple in construction and method of operation, durable, inexpensive to manufacture and highly efficient.

FUSED PLUG—W. F. THOMAS, 212 Miesopie Blvd., New Bedford, Mass. The object of the invention is to provide a construction wherein only the plug proper is fused and is in any given circuit. Another object is to provide a fuse plug using porous, instead of a threaded sleeve, and to provide a construction of plug and socket, which will not only require the use of a screw and plug, but will indicate the size to be used.

CEILING FAN—M. M. GLASSER, 42 Lawrence St., Charleston, S. C. The invention relates to motor operated fans, and particularly, although not exclusively, to ceiling fans, the purpose being the provision of a ceiling fan which provides simple and effi-

cient means for effecting the bodily oscillation of the fan wheel whereby the air currents produced by the fan is continuously changing over a constantly changing area.

Of Interest to Farmers

BEST HYDRAULIC LIFT—L. W. CHASE, Box 4, Fallon, Nevada. Among the objects of the invention are to provide a best hydraulic lift that will run the best before lifting them out of the ground, the device having a vertically adjustable wheel, and an adjustable width of track so that it may be adjusted to the width row, and may at the same time be used in connection with cultivating tools, such as weeder, shovels, plows, etc.

CROP DUSTING MACHINE—C. G. LAMBERT, Niagara River, Ontario, Canada. The invention more particularly relates to a feeding hopper for dusting machines for applying chemicals in powdered form to growing plants. Among the objects is to provide a hopper for carrying the chemicals, and to provide a feeding mechanism within the hopper which may be adjusted in such manner as to vary the quantity of chemical discharged over a given area.

TRACTOR CULTIVATOR—C. B. LAWRENCE and G. H. HARRIS, Portsmouth, Va. The object of this invention is to provide a tractor cultivator having a capacity for carrying out the various earth working operations, and adapted to be conveniently controlled by a single operator. A further object is to provide a tractor cultivator including a single tractor wheel, and driven from a power plant comprising a pair of cylinders arranged as to be susceptible of independent movement. The adjustment of the gears, thereby eliminating the necessity of employing a clutch.

COTTON HARVESTING AND CONVEYER—D. DAVIS, 412 R. Marshall St., Little Rock, Ark. The object of the invention is to provide a cotton harvester and conveyer of extremely simple and durable construction reliable and effective in operation, to perform a maximum amount of work at a minimum expense. The apparatus comes a wagon, a fan exhaust and suction blower, a flexible pipe and harness to effect the carrying of the same by the plow.

PITCHER—E. LEITCHER, 850 E. T. Knudsen, Milford, Utah. The invention relates to a pitcher wherein any of the three may be renewed and replaced at any time, the chamber being provided with a plurality of sockets, the stem having three upper ends adapted to fit the sockets, and a pin extend into the stem for locking the shaft into place. In this way the breaking of a line is not a great misfortune as repairs can easily be made. (See Fig. 2.)

ATTACHMENT FOR GRADERS—A. CARL, Rio de Janeiro, Brazil. The invention is more particularly to a supporting also adapted for connection with a road grader or scraping machine for the purpose of bridging wash-outs or depressions in the side of a road to prevent the rear outer supporting wheel and the blade from dropping down and entering the depression where. The attach-

ment is provided with means for adjustment and is operable by the operator of the machine.

GRASS-DIGGING IMPLEMENT—W. L. POWERS and J. WILSON, Miami, Fla. The invention relates to an implement for removing weeds from a field. The object is to provide this character of simple and efficient construction which when drawn over a field automatically removes the entire removal of this grass from the soil. The device includes digging blades for loosening the soil, and object units for removing the roots.

Of General Interest

POLYANT PEN—J. L. H. RAY, Box 504, Waverly, Ave. Syracuse, N. Y. This invention has for its object to provide a self filling pen which comprises a mini man number of parts, yet will hold a relatively large amount of ink. A further object is to provide a form cylindrical plunger to act as a self filling device. When the ink runs low the plunger and sleeve are forced downward, the pen is inserted in an ink container and the plunger and sleeve are pulled back toward their normal position, so the ink will run the barrel. (See Fig. 2.)

RETRACTABLE FIRST HAIT—W. F. KOUR, Rudland, W. Among the objects of the invention is to provide a line which when used in trolling will give the bait the appearance of a live fish, the bait being of such a shape as to automatically move back and forth and pull through the water in a fluid motion, the shape being as follows: that the lure will turn on its side and sizes.

MEANS FOR MOTHOOTPROOF FURNITURE—J. J. WENGER, 318 W. Madison St., Chicago, Ill. The object of the invention is to provide a means for mothproofing furniture which may be disposed along the seams of the furniture, thereby effectively protecting the entire article, so it at the same that the moth material to provide device which may be disposed in any seam of the furniture, and secured as the latter is below manufacture without changing the furniture in the slightest way. (See Fig. 3.)

INSTANT TRACK—H. C. KOLLEGE and W. MCGILL, 1147 S. W. 10th St., Wichita, Kan. The invention more particularly relates to tracks which are adapted to be placed upon a series of steps, such as those found in a building, and provide a plain surface one which is reliably supported by a series of steps or furniture, may be easily moved without being subjected to shock by the feet.

MARINE PROPELLER—O. W. LAW, 935 62nd St., Brooklyn, N. Y. The object of the invention is to provide a propeller which will increase the power of any screw propeller by a minimum amount with a expenditure of energy. One of the main features resides in forming the blades with a curved surface of substantially the same width throughout the bow. A further object is to construct a propeller in which the leading edge of the blade extends in advance of the forward end of the hub to obtain an initial

purchase on the water forward of the hub to avoid stalling.

COLLAPSIBLE CORE—J. F. WALLACE, c/o Dept. of Water and Supply, Room 2844, Municipal Bldg., New York, N. Y. The invention relates to a core used in forming a concrete column. An object is to provide a collapsible core so formed as to be built into a normal formation for making a durability of concrete castings for the use of electric wires or other similar use. A further object is to provide a core with hinged parts so formed as to be readily disassembled for permitting removal without disast.

STAIN PAIN PILLER—P. R. HAY, Box 10, Church St., New York, N. Y. The invention has for an object the provision of means whereby a substantially full supply of ink is drawn in upon each filling operation. A further object is to provide a ink saving a collating mechanism for the ink and means consisting with a threaded top which will permit the map to have a dead motion for part of the time during its operation in order to give the map time to distend and draw in the ink.

RAPID LAMINATOR—J. J. BROW, 112 W. 10th St., New York, N. Y. Among the objects of the invention is to provide a simple form of many parts wherein the blade may be readily inserted and removed and when in place is rigidly clamped against accidental movement, and wherein an arc-shaped ridge is presented with guarding members so positioned as to prevent accidental cutting of the face.

ARTICLE OF FURNITURE—P. CAMERON, 12, 22 E. 10th St., New York, N. Y. The invention relates to collapsible furniture of a readily portable type. The invention object is to provide a structure which may be provided with a collapsible vertical wall, such as two walls to make a corner cabinet, or three or more walls to make a cabinet of different size to be placed anywhere in a room.

ENVELOPE—BRYAN L. HERRMAN, 221 E. 10th St., Phoenix, Ark. This invention relates to a means for connecting a series of envelopes, sheets or other suitable matter. The object is to provide means whereby the operation of a typewriter may quickly add a large quantity of envelopes by reason of the fact that they are constantly in ready position. The envelopes are adjusted to permit of single, double or triple spacing, thus saving the time and trouble of removing after the envelopes are addressed. The flaps may be detached and sealed without individual ink signs thus a great saving of space and time. (See Fig. 4.)

PHONOGRAPH RECORD—W. C. HANCOCK, 1141 R. H. University St., New York, N. Y. The object of the invention is to provide a phonograph record which may be used on any of the well known phonograph machines provided with an automatic stop, so constructed that it may be possible to accurately control the stop mechanism to be operated at a definite point, and having been so it may be permanently locked and operated with any

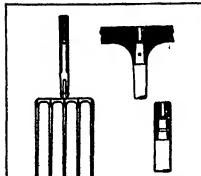


Fig. 1. A perspective view of a mechanical device, likely a switch or plug, showing its internal components and a handle.



Fig. 2. A perspective view of a mechanical device, likely a tractor cultivator, showing its frame, wheels, and a plow attachment.

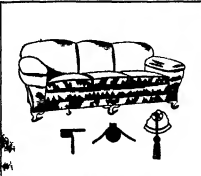


Fig. 3. A perspective view of a mechanical device, likely a marine propeller, showing its blades and hub.

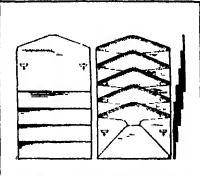


Fig. 4. A perspective view of a mechanical device, likely a phonograph record, showing its surface and grooves.



**The New Tuska
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Licensed under Armstrong
Patent No. 1,113,149
Special circular 20-A
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Like a good old reliable friend

YOU turn to your Tuska radio set with perfect faith that it is always ready to be called upon. There is no fussing or coaxing—no apologies for its shortcomings. Year after year you can count upon this reliability of performance. New models will come, as in pianos and fine motor cars. But few will discard the old and buy the new for the sake of minor refinements. The Tuska set represents the highest point in radio development to-day; you can buy it for the future with confidence.

The Tuska is the ideal set for busy people who want the thrills of radio without the tinkering. It is simple to operate. You turn two dials, listen, and select the exact program you want from the dozens which fill the air. Nothing is forced upon you by the

limitations of your set—every broadcasting station within hundreds of miles is within the call of your Tuska. A letter from Prince Albert, Saskatchewan, Canada, says, "We have tuned in clearly over 100 stations and most of them are more than 1000 miles away."

Tuska sets are built under the personal direction of C. D. Tuska, a nationally known radio pioneer and builder of fine apparatus. For a dozen years Mr. Tuska has been keenly critical of all radio parts and sets bearing his name. As a result, the Tuska seal is recognized as a guarantee of the most thorough New England craftsmanship—and there is no better.

We will gladly send you the name of a near-by dealer who can show you the Tuska.

THE C. D. TUSKA CO., Hartford, Conn.

First to hear across the sea

A Tuska Receiving Set was the first to receive foreign amateur trans-Atlantic code during the international tests.

Tuska distance records

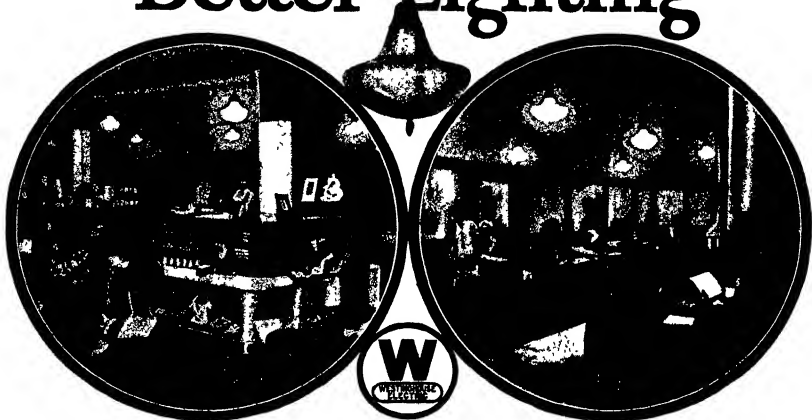
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COLGATE'S

HANDY GRIP

The Refill Shaving Stick

Botanical Notes

Dates from Asia. Turkey supplies most of the furs imported into the United States. In 1921 total imports of dates amounted to 40,000,000 pounds, of which 20,000,000 pounds came from Turkey in Asia and more than 2,000,000 pounds from Palestine and Syria.

Dr. Carter's Researches.—Dr. Carter developed the hypodermic of the peanut and 115 of the sweet potato, has made potato, and chinaberry meal from the chinaberry and made a tonic for stock food from vegetable products. He also devised a dressing for canvas shoes and whites and colored washes from clay, has used oaks fiber for making paper rope, canvas, straw matting and carpet and has made 20 varieties of laundry mangle. The Sphagnum metal, given usually for the most notable achievement by an American citizen of African descent, was awarded to Dr. George Washington Carter of Tuskegee Institute for his remarkable researches in agricultural chemistry.

Worms Eaten Wanted.—An American exporter sent an unusually poor consignment of oak shroud to his overseas consignment, which was found to be wormy, but no market could be found for this parcel. This consignment would have caused a great loss to the exporter were it not for the fact that the consigner happened to visit an antique furniture factory. The manufacturer was at that time busily engaged in making antique grandfather's clocks, and found the oak shroud to answer his purpose very nicely, because it eliminated the work of boring holes "by hand." The parcel was disposed of at a premium, and a profitable connection was established.

The Thompson Institute for Plant Research.—A statement issued recently by Dr. William Crocker, Research Director of the new Thompson Institute for Plant Research, established in Yonkers at a first cost of more than \$500,000, gave details of the plan by which powerful electric lamps are to supplement sunlight in growing plants. "This new institute with its greenhouses and laboratories," said Mr. Crocker, "is to be to plants and flowers what the Rockefeller Institute is to humanity in other words, it is to study and try to cure diseases of plants and flowers and other vegetation. Eventually the institution is to cost \$2,500,000. Seeds from the tomb of King Tutankhamon will be tested for germination in the new laboratory."

The Oldest Living Things.—As the largest existing organism, the "Big Trees of California" occupy a place unique among the living things of the world, said Dr. H. A. Gleason, Assistant Director, lecturing at the New York Botanical Garden. While they may be exceeded in height by some of Australia's gum trees, as they are exceeded in diameter by the chestnut trees of Italy, in actual bulk, said the lecturer, they are far greater than either of those. Authenticated measurements show that California's big trees have reached a diameter of over 30 feet, heights of more than 300 feet and age well over 3000 years. Since they do not suffer from disease and are not seriously injured either by fire or lightning, and since trees apparently do not die of old age, the usual cause of death among the big trees is by the undermining of the root system through the gradual removal of the soil by water.

Lane Turpentine and Rains Foreboded Since World War.—Figures showing the distribution of the world's production, and consumption of turpentine and rosin have just been published. According to the best information available, says the report, the average annual production of those two important commodities shows the outburst of the war has been from 20 to 25 per cent less than it was before the war. This is due chiefly to the decrease in the American supply, caused by the depletion of timber suitable for turpentine operations. The United States furnishes between 60 and 65 per cent of the world's supply of turpentine and from 70 to 75 per cent of the world's rosin. The United States not only produces most of the world's turpentine and rosin but also uses a larger part of it than any other country. Roughly it consumes between 50 and 60 per cent of the total world supply of turpentine and about 20 per cent of the rosin. Forty-five per cent of the turpentine consumption is by the paint and varnish industries, and it is estimated that an additional 60 per cent is used for thinning down paint and varnish when they are applied. Forty-two per cent of the rosin is used for soap making, with the paper industry consuming about 25 per cent.

A 2½ Mile Cut Through Brass with ONE Saw Blade

—and the blade is still running

More than 40,000 pieces of 1½" brass tubing have been cut with one saw blade and the blade is still good—a wonderful testimony to the smooth, chisel-like operation of the

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The Racine Duplex Band Saw is an accurate, rugged, precision machine tool designed by experts in metal cutting machinery. It cuts round and square shapes in 1½" to 12" bands, round and square pipes, and is a handy work tool for the machine shop. Can be found at the post most convenient to the work.

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walls. It combined us strongly of our payable experiments here in New York, when we exposed one of the leading medicines after three days.

At the command of the Colonel, the demonstration got under way. In a few minutes we were surrounded at what we were witnessing. It seemed unbelievable, yet it was there, in this black and white. We had been brought face to face with certain facts regarding the human mechanism which we would hardly dare to have surmised in the absence of such a convincing demonstration. We were shown how—well, at this point we can go no further. Colonel Falyan made us promise that nothing would be said about the nature of this investigation until some later date, when the experiments have progressed further. Free science is a slowly moving thing. Publicity is something to be guarded until the desired results are obtained. It may take weeks or months or years. Meanwhile, the public must wait until the scientists reach a point somewhat nearer to their objective.

So, his startling claims are being done at Riverbank, under the cloak of secrecy. It is such work as this, conducted by such an institution, which will unfold to us new wonders within the next few years. We shall learn more about the human body than ever before we shall want certain secrets from nature which have never even been suspected. A new epoch will most likely open up. Every so often the world reaches a point bordering on stagnation, because everything seems to be fully developed, just as a field, after being thoroughly cultivated year after year, exhausts itself if fertilizer is not added. But the scientist, peering ever at the secrets of Nature, sooner or later breaks down existing barriers, opens the way to a new field, and we are soon confronted with new and new opportunities for exploitation.

And About the Man Behind the Idea

It would not be right to close this account of Riverbank Laboratories without a little sketch of Colonel George Falyan, although we were told that the Laboratories were the thing to describe and that he was not to be mentioned. Still, the Riverbank idea is the Colonel's premise, and we must therefore sketch a word picture of this remarkable man.

Colonel Falyan, we gathered, is a self-made man and looks the part. He is a big man, well along in life but in the very best of health, as depicted by his rugged appearance. He has prospered in the cotton business. Although not a traditional scientist, he has always taken a keen interest in medicine and medicine and other branches of science, and it has been his own ambition to establish a private laboratory for the purpose of trying into Nature's secrets. He devotes his time and much of his money to this work in memory of his mother, and we noted a tablet to that effect in one of the laboratory rooms.

The Colonel acquires specialists in various lines and gives them every facility for developing new ideas and trying into old problems not unsolved. The specialists receive full credit for the work they do. The laboratory workers live in what is called "The Community," which is a very essential part of Riverbank. In our short stay at this institution, we noted the wonderful spirit of most fully and harmonious which permeates throughout the Riverbank Laboratories, as well as the admiration, intense friendship, and loyalty in which the workers hold the Colonel, who is so interested in the activities of each and every worker.

Confidentially, we may add in closing that the Colonel has a quiet hobby—cryptography, or the ciphering and deciphering of codes. He has gathered together and studied everything available on the subject. He has compiled notes of his own and torn apart the codes of others to learn their import. He has deciphered many old-time cryptic words, such as some of the writings of the illustrious Roger Bacon of long ago. Indeed, Col. Falyan is considered one of the foremost cryptologists in the world today. During the World War he served as a Colonel in our Army, and established school at Riverbank for the training of Signal Corps officers in cryptography. The Office grade of the Legion of Honor, the Order of the Rising Star and other decorations, as well as rare testimonials from our Government, bear witness to the Colonel's attainments in this study which is the core of a remarkable man.

And so we come to the conclusion of the story of a remarkable man, whose remarkable idea which has materialized into a remarkable institution.

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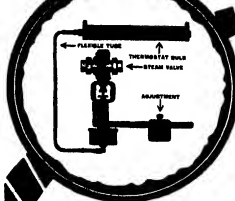
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KEYSTONE COPPER STEEL is an alloy made by the addition of a small amount of copper to the steel. It is a stronger material than ordinary steel and is more resistant to corrosion. It is used in the manufacture of automobile bodies, truck bodies, and other light weight structures. It is also used in the manufacture of machinery and other heavy structures. It is a versatile material that can be used in many different ways.

Sprayed Rubber

(Continued from page 205)

revolutions per minute. It completes a position slightly before the setting of the lower chamber. Here is the spectacular part of the process. Reaching the center of the whirling disk the rubber milk is instantly taken up and whirled from it in a column of minute atomized drops. Since they fall continuously they form an umbrella-shaped dome of mist. Instead of spray changing quickly to rubber in the intense heat of a draft of air heated to 500 degrees Fahrenheit in a large furnace situated on the upper floor. This is conducted down into the drying chamber by means of four large furnace pipes. The mist of drops rapidly forming thin flakes of pure rubber may be observed in comfort through a tiny glass window let into the wall of the structure opposite the eyes as one stands on the narrow platform that runs across the lower.

The great heat dries the minute drops of latex speed so quickly that no injury can come to the rubber from prolonged heating. Not only is the water of the natural latex driven off but the liquid ammonia, which was added in Sumatra, flows in gaseous form through a special port in the walls. Its odor is readily detected around the unit. Before the drying latex has reached the floor of the chamber it is rubber.

The latex could be caught on the floor itself, but that would necessitate stopping the process from time to time to permit its removal. If the process is to be a continuous one the accumulated rubber must be removed frequently and in small amounts. This is provided for by covering the floor entirely with a number of narrow platforms 20 feet long by about 3 feet wide. Each platform is mounted on casters. As a filled platform is withdrawn from one side of the chamber an empty one is pushed into the other. The removal is effected by a line from a small wheel hooked to the respective ends of the platform and pulled, beginning with one end so that the superfluous rubber is parted along the division between two platforms. As the coating of rubber is continuous one would naturally anticipate great trouble in doing this. But while this must come apart as easily as a couple of helping paper sheets—and resembles them in some ways.

The platform comes out into the shed covered with a blanket of clean rubber about its inches thick in the center where most of the latex fell and tapering off to an inch at the ends. It smells like newly baked bread. It feels like sponges and if squeezed in the fingers it falls to return to its original form. Between the little flaps air is imprisoned, giving the mass a whitish or light cream color. While warm it is easy to break off a chunk of the rubber; but if allowed to cool all the strength of the mass cannot tear off a sliver as large as the little finger.

While still warm the large slab of rubber on the platform is broken up into pieces of irregular shape so that they may readily be handled. Twenty-five pounds of them are weighed out at one time and placed in a hydraulic press which comes down on them a moment, squeezing out all the coils of air and consolidating the sponge into a beautiful translucent mass of rubber the color of pulled taffy candy. It is now solid, and extremely strong. This rubber is ready to be vulcanized and used.

A variation of the latex spraying process is being used in the manufacture of automobile cord tires. The latex flake made by the new process has no need of threads. These are unnecessary because the cords are held rigidly parallel until saturated through and through with latex. Then this is dried into a continuous piece of rubber. The cords are led from spools through a bath of latex which so thoroughly soaks into them that microscopic examination has revealed its presence in the center of every of the little cotton fibers, of which in the finest cords are over 115 inches in length. Still maintaining a parallel relationship and, equally important, having cords remaining their cords are led through a series of drying devices. Eriph the latex which is the outer sheen, that which is between them and that which is between the cords into a single piece of fabric which may be stretched diagonally with but the least injury or permanent displacement of the cords. The fabric has been made instant with the rubber itself. The heavy and takes up its stretched state of its stress to the tire.

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machine, and hence before it had played a role. Fanny objected that she didn't want that. Mrs. Leo said she had a true sense of imagination, how she could tell whether she wanted it before she knew what it was. Fanny replied promptly and in unusually good roles that she knew quite well what it was. That it was "The Tale of the House," and she didn't want it and wouldn't have it. It was laid aside for identification, when the light should be restored, being placed upright in Mrs. Leo's chair, behind the lady's back. Presently, forgetting that it was there she leaned back and stretched it. At the end of the season, this broken record was found to be the one that Fanny had named. If we admit the good faith of Mrs. Leo and the impossibility of Miss Dyle knowing by memory what this record was, we have here something that occurs periodically close to passing the bounds of telepathy and falling in the field of pure divination.

From time to time various of the latter announced occurrences or other touches, those that touched me were just about like the ones I had felt in previous seasons, and all for nothing beyond the mere chattering. That two voices never appeared at once I am quite certain, also that no two objects were moved about the table at the same time. It is my impression that several times we had lights and voices simultaneously, but of this I cannot be absolutely certain.

Several of the sitters at one time or another announced the cold breeze or characteristic of the season room. One Mr. Arthur and I got a powerful blast of this, there could be no mistaking its objective character, or the fact that it came from the direction of Miss Dyle.

Turned the table and we had a gorgeous array of table tilting. Miss Dyle would announce it in advance, and called for all the hands to be placed in direct contact, at the very edge of the table. My left was an exception, it remained out on the table with the medium's right hand bent. Knowing what was coming, I purposely bore down as gently as possible, and therein, for my pains, I had my hand pressed more firmly upon hers, by what I took to be her left hand. Aside from this, her left was unaccounted for.

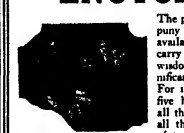
The table gave a few preliminary shivers, and then rose, in everybody's very positive belief, entirely clear of the floor. Suspended in the air it grated in a curious back-and-forth up-and-down fashion, which I can describe no better than to call it a figure-of-eight motion. Presently it settled back to earth.

I handed the table considerably during the clearing for action, and I judge it weighed fifty pounds at least. I am perhaps not so strong as the medium, being built along the general architectural lines of a drink of water, but I could not move within forty miles of juggling the table as it was jugged, if I had two arms and two legs to work with. From a well-defined position. The suggestion has been made that only the top of the table was moved, and that the rest of the table was merely moved away from the top. I am inclined to believe that the table was moved, but I do not believe that Dr. Dyle has a conjurer's table in his dining room.

The grand climax of the Boston season, spiritually speaking, is the materialized person. Here a word of explanation is in order. Mr. James Black once asked the question of the medium, how she could move her materializations turned out to be Miss Dyle herself, out of her seat and bring over on the table. Had Mr. Black known a little more about the subject, he might have pointed the actual figure of seven, but in a different direction. It is admitted by the medium and her sitters that the materializations are not always independent of her own physical form. The claim is that when the power is good the figure of sufficient materialization to form a complete form or even a complete figure, but that when the power is less, she can only produce enough of this materialization to be used as a mask or veil, over the foundation supplied by her own face. Her face is then thought of as having been "materialized" extraneously into a resemblance to the features which it is desired to present.



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so regulated by carefully adjusted flaps so as to maintain a uniform depth as shallow as is consistent with safety.

The boiling plant of an up-to-date plant is a substantial frame building of three rooms, exclusive of a shed for the storage of an ample supply of fuel. The main room is used for the evaporation of the sap. A smaller room is for the concentration of the syrup into the form of sugar, and the third contains the storage tanks, which of late years are of heavy tin, though formerly wood was the material exclusively used in their construction. The evaporator, of which there are many styles, consists essentially of a battery of shallow pans set upon a cast-iron arch, in which a blazing fire is constantly maintained. Several of the pans have corrugated bottoms, through which a greater surface to the action of the heat, and they are so arranged that the sap flows in a continuous course from one into another, constantly becoming more concentrated. Before the last compartment reach the boiling plant is approximately at 210 degrees.

It is then drawn off and filtered through flannel cloths or felt strainers to remove the minute matter held in suspension in the sap. This consists chiefly of a compound of lime with malic acid, technically, calcium malate, but locally known as "water sand," and also as "litter." Until very recently this has been considered as of no value, and thousands of pans in the aggregate have been thrown away. Recent investigations, however, indicate that malic acid, a substance selling around \$10 a pound, may be extracted at about a very nominal cost, and the stuff promises to have considerable commercial value in the future. But the filtered syrup is placed in a wooden pan, returned to the fire, and further concentrated to the desired density. If designed for maple syrup, it is standardized at a temperature of 210 degrees, making an allowance of one degree for every 500 feet of variation of altitude. It is then removed from the fire, again filtered and poured into the containers, which are then hermetically closed. At the present time, the bulk is made of tin and fitted with a screw-cap, is the container most in evidence. If designed for a soft sugar, the syrup is concentrated to a temperature of between 220 and 224 degrees, as desired, the former representing an 80 and the latter an 85 per cent sugar respectively. And a representative of 245 is now given indicates a 90 per cent product. This is as far as it is practicable to concentrate the syrup in the little bottomed about from pans in universal use in the United States, but the Canadian makes, using thick, stout iron bottom, is able to concentrate the product to a water content of only 5 per cent.

The cost of an equipment for operating a maple sugar-making plant is about one dollar per ton, exclusive of the boiling house, which may be as elaborate and expensive as one may please. The labor cost is small, and concentrating the sap varies greatly, but it is generally assumed that one man and team can gather and attend to about 100 trees the yield of 500 tons. Under the most favorable conditions he may be able to do much more, and under unfavorable conditions he may not be able to do nearly as much. During the past few years many maple sugar makers have installed systems of sprays which take the sap directly from the tree to the pan from convenient stations and convey it by gravity to the storage tanks, thus largely reducing the labor cost. But it is the other cost that has led to this. This varies according to local conditions, but it is calculated that one cord of good wood, rightly handled, is sufficient to concentrate a sufficient quantity of sap to make 1000 pounds of sugar.

On account of the cost of production and the comparatively minimal quantity which it is possible to produce, maple sugar can never compete with cane or beet sugar for general purposes. But as an auxiliary to supply the table with a most delicious sugar, and also use as a confection, it is playing its part in the health in conserving other forms of sugar.

On Reservoir of Energy

(Continued from page 185)

The upper atmosphere contains enormous stores of electrical energy which are continuously being regenerated by solar radiation, winds and other influences. No doubt the day will come when great forces will be created for tapping this vast supply. The chief difficulty in the way may be that the atmosphere, even when damp, is so poor a conductor that a single thread of wire is an insignificant portion of the path. The presence of a small amount of sodium, how-

ever, makes the air a conductor of electricity for a considerable distance around it. It is a very likely that we shall one day find a much cheaper means for this rendering the air a conductor, so that towers built of considerable distances apart on top large fields of atmospheric electricity.

There are still other promising methods of deriving the sun's heat. A pet dream of the writer has been the conversion of the sun's heat into electrical current by means of a thermocouple. When a thermocouple, he constructed an apparatus consisting of a number of thermocouples connected in series, and found that a small amount of heat was needed to start an arc that by burning a candle or even a match it was able to develop a small continuous current of about a volt for experimental purposes. There is nothing inherent in applying the same principle to the generation of the sun's heat except the large initial cost of plant involved. It is not unlikely that this difficulty will some time be eliminated.

We need never fear exhaustion of fuel, for it will never come. We will slowly cease using it and begin using other sources of power as economic considerations dictate. But it will be a development so gradual that we will not be conscious of it. It is being won over today.

The Inventor and the Gay Gambler

(Continued from page 141)

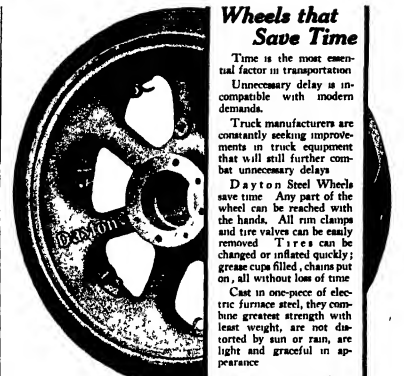
"This machine can be played with a soft flannel shirt. It is absolutely mindless, no complicated parts and nothing to get out of order. It is the only machine on which you can win an article or a prize without using the machine to operate with either a hand pump or a straight leg movement, as preferred."

The central mechanical contrivance of all these affairs is a fine foliot and extending device of some kind, varying slightly according to the nature of the game. The three extending devices are like the foliot spring, but they are not on the same principle. Others work on the pneumatic principle, the arm being extended down by a pressure of air. What hasn't been devised today will be in the market tomorrow. The variety never is exhausted, and the number never tires.

We come now to that other celebrated invention of gaming, the roulette wheel made famous by Monte Carlo. It has often been said that this is one of the fairest games for the amateur, and this may be true even if the wheel is operated as the famous Monaco resort. There the roulette wheel contains the usual thirty-six numbers and a single "zero" or zero. A dollar bet on any number pays thirty-five for one. The laborer receiving the dollar's book of course, so, if you bet on a number the book has thirty-five other numbers and the zero against you. The percentage of the laborer out of thirty-six. The roulette was adapted for American use, however, and "green," the double zero, was added. The laborer out of thirty-seven. The gambler once told me: "Since the ratio of payment for my wheel is thirty-six to one, about, 35 for 1, this change has simply meant an additional chance for the laborer. In Europe he is paid 35 to 1 for playing 36 to 25. Here he gets the same ratio for playing 37 to 27. The gambler's percentage is thereby doubled. Instead of being a little more than three times the laborer becomes about six and one-half. This is a ruinous handicap upon the laborer, and it is the only thing that kind satisfies the gambler as we know him today. With all our respect for the laborer, the only absolutely 'straight' wheel now operating to my knowledge is at Monte Carlo. It is so known personally about Cuba, but what reports have I may say are not trustworthy."

The roulette wheel came into America about thirty-five years ago. Since that time investors have constantly improved on the methods used for its corruption. One early and obvious contrivance was a little mechanism which applied a brake, first to the rim and later to the axle, when the wheel was allowed to run until it had almost lost its momentum. Then the cropper or an assistant leaned against a lever which applied a brake just after the heavily played number had reached the top. The wheel came to a stop and the ball naturally fell into the pocket chosen by the cropper. The wheel which was being played lightly or not at all.

Next came the knockoff or snail's race, a small snail, nearly out of the track in which the ball revolved about the numbered wheel, which is retarding in the opposite direction and so added to a button that it



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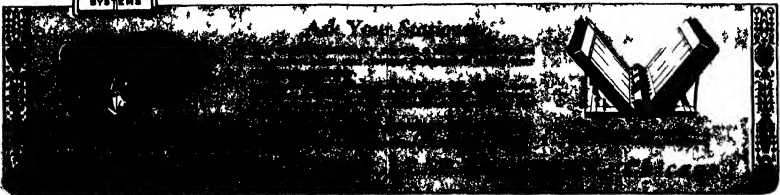
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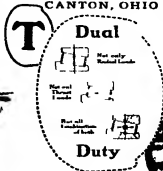
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WHERE FIRE RESISTANT ROOFING SHINGLES MUST MAKE GOOD THEIR CLAIM - [See page 234]

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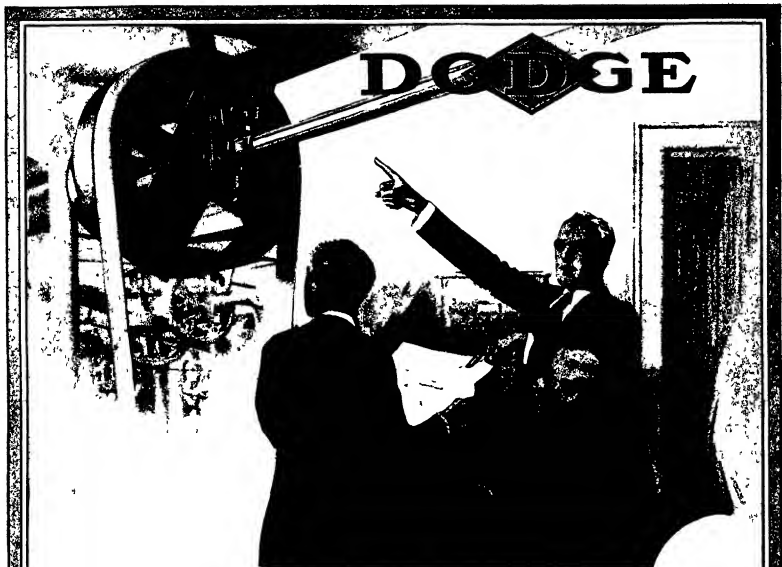
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THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, OCTOBER, 1923



One way in which traffic could be made to flow smoothly through our congested cities. The suggestion is made with particular reference to New York, but is of universal applicability.

NEW YORK CITY is laid out on Manhattan Island, twelve miles long and two wide, and though the city has spilled out in all directions, its traffic problem is centered here. Crowded traffic is intrinsically large, but in comparison with the flood of vehicles morning up and down the island it shrinks into insignificance. And herein lies the one feature of New York's problem that distinguishes it from that of all other cities. To carry the small fraction of the total that moves east and west there are over 500 streets, for the enormous volume of vehicles that run parallel with the island's long dimension, there are eleven thoroughfares that start sufficiently far downtown and are not interrupted by Central Park. Under no conceivable arrangement of grading facilities will there ever be other than extreme congestion.

There are two obvious reasons that would bring some relief. One reason for the slow movement of traffic as a whole lies in the presence of cars, trucks, horse-drawn vehicles and trolleys, all on the same street. With one or two exceptions none of the streets is wide enough for more than two lanes of traffic in each direction, and three of them suffer the further complication of being more or less obstructed with elevated pillars. Trolleys and automobiles must stop to take and discharge passengers, and even parking cannot be entirely banned. The net result is that traffic does not flow, it crawls; and the only conceivable remedy is segregation of the various classes of vehicles upon thoroughfares of

their own. The subway and the elevated are fast mainly because they automatically effect this segregation—they make their own pace, instead of having it made for them.

The second root of traffic evil lies in the intersections of crowded streets. Crowded traffic is not large in the aggregate, but it tends very strongly to concentrate upon a few streets—a dozen or less of these certainly carry 80 per cent of the traffic. A street leading from a bridge or a ferry is peculiarly subject to this concentration of traffic. And when the two streams, one running north-and-south and one east and west, meet—well all the traffic towers and traffic officers in the world could not maintain a smooth flow. Ultimately the grade-crossing must be eliminated where two main arteries of automobile traffic meet.

Shrews are ever being put forward for relieving New York's traffic jam, and when one is found that is successful it will be of country wide interest and will be universally copied. For the suggestion illustrated on this page Mr. Cameron Clark is responsible.

Mr. Clark would plant a sunken boulevard, 100 feet wide, in the center of Manhattan Island and running substantially its entire length. This would give space for four lanes of traffic in each direction, with an extra one on each side for stalled cars. Where the capacity of Fifth Avenue is but 2000 vehicles an hour, and that

of Park Avenue at the Grand Central station only 1000, such a thoroughfare would accommodate 18,000 per hour and stop gridlock would be excluded, hence the speed safety attainable in the boulevard traffic would be greatly increased.

Across the boulevard would be by single-track inclined ways, that would slip down the embankment at the side. From every alternate cross street these would run in either direction to meet the boulevard. The one would be for entrance to the thoroughfare, the other for exit therefrom, as indicated by the arrows on our drawing. There would then be no turning whatever on the boulevard itself. Traffic would flow in and out on purely entering lines, with no confusion. For thoroughfare would be obtained by a pronounced obstruction in the middle between the north-bound and the south-bound thoroughfares. A driver wishing to turn and go back would have to run up one of the approaches, cross the bridge and run down on the other side, putting the inconvenience of his maneuver upon his own shoulders instead of compelling approaching drivers from both directions to modify their pace for him.

Mr. Clark would locate this boulevard on Second Avenue, and he would carry it across Canal Street and back up town on the west side to connect with Riverside Drive. Real estate values along such a location would be moderate, excess condemnation might pay for the whole project.

Protecting Our Great Banks

Armor of Concrete and Steel that Aims to Foil the Scientific Cracksman

By Edward H. Smith

ON a memorable Monday morning in 1879—October 28, to be precise—the caskey of the old Manhattan Savings Institution turned the key to the lock of the street door, walked nonchalantly into the bank and found the great men. Men will do strange things for love of self, and one had been thinking the door of faint men would open.

The room and the faint men vanishing upon term and twisted on their hinges, we thought a little. Then had seven bank men, the wealth of mountains and the power of tides. On the floor was a litter of papers, account books, checks, pieces of shattered iron and ends of broken rods. From the interior of the huge metal box hung coiled fire and the strength and intensity of men, was missing a total of \$2,747,000 in cash and bonds.

The greatest bank robbery in our history had been committed between Saturday night and that night day.

The author revived, summoned the other officers to haste, closed the doors and set out a sign reading that the bank had been forced to suspend because of robbery. Police came in droves, crowd gathered and tried to storm the entrance the news spread through the city and across the country, runs on other banks began and were closed. The corner of Broadway and Fleet Street, where the bank stood, was dismantled for many days with crowds of curious people who had come to see where this astounding thing had taken place. The small gang of crooks became a famous place of history.

To this burglary just forty five years ago, is to be traced the beginning of modern developments in the protection of our great banks against criminal attack, so it may be worth while to glance at some of the facts concerning it.

ing and a notorious professional bank burglar, lured by the famous Zimmo Hope, had laid plans for the attack on the Manhattan Savings Institution and consumed all of three years in working out their scheme. The bank was closed for business on the night of the bank watchman, gained entrance to the place with little collusion and worked on the vault door with wedges, powerful jackscrews and explosives, through the night of the 10th and 11th inst. The bank was opened at cash at about 7:30 o'clock on Monday morning. Their loot consisted of \$2,500,000 in registered bonds, \$75,000 in coupon bonds and a fortune in cash. To save the banks from a similar fate, the State Legislature passed acts cancelling the registered bonds and causing foreign securities to be obtained and issued in their stead. To such lengths the State went to protect its finances against a few men, bold and clever men.

It must not be assumed that such a haphazard rule as that on the Manhattan Savings Institution had happened without precedent or that the banks had not done what they could to prepare for such attacks. The burglary of large banks was an old story in 1878, and great quantities of inventive energy and of bank money had then already been expended in the quest of some method of vault construction that could be relied upon. It is interesting to note some of the ideas then applied

The vault of the old National Park bank when it was finally dismantled some years ago, to make room for a modern substitute, was found to have been built of solid slabs of granite, closely fitted together. The edges of each such slab had been incised with a series of hemispherical depressions, which fitted precisely to similar scoopings from the adjoining granite blocks, thus forming globular holes, five or six inches in diameter. Into each of these holes a cannon ball had been

placed, so that if a burglar tried to enter the vault by digging at the joints of the stones, he would encounter the loose cast iron balls.

Another view, of a slightly later period, had been formed, inside a construction of solid masonry, of two plates of cast iron, each about one-half inch thick. The inner face of the plates was covered with stannic acid. The inner face of the plates was covered with stannic acid.

But all such precautions were not of much avail, for the reason that the better bank burglars of the day understood how to attack the strongest vault known then in existence. Invention had provided nothing better than heavy, close-fitting doors of cast iron, chilled

and later case hardened, but iron doors, after all. We shall have a word to say about the evolution of the vault door. For the present it is enough to observe how burglars, without such weapons as they now possess, ripped their way through the no doubt formidable defenses of the old banks.

under the name of Yonah. City foot of the same 1380s, Hope will illuminate the matter. In the fall of 1898, Hope rented a basement under the rooms of the Ocean National Bank at the corner of Fulton and Green Streets and opened a carpet business. In front was his show room, in the rear his work room. To divide these and keep customers and powerfully from intruding on his privacy, he had a partition erected, dividing the two parts of his establishment. In reality this ceiling high screen was put in place to mask his operations against the bank, whose vault he had secretly studied.



A 30-inch thick block of steelcrete (concrete and steel) after a laboratory attack lasting only a few minutes made with modern tools.

chase from heavy iron bands or cables which had been passed around the vault or secured to its bulk by heavy hooks. Gradually the jacks were turned until the thick wedges forced their way in and prised the door from its iron join. The bolts were now forced back and the work was done. Explosives and heavy crowbars were then used on the inner iron door. This robbery totaled \$1,200,000, of which, fortunately, the larger part was in non-negotiable bonds.

[illegible]

To day, in the best modern vaults, only one type of door is employed, the so-called ping door, shaped exactly like the cork of a medicine bottle, with smooth edge, no steps or grooves and slightly smaller in diameter inside than out. Such doors vary in thickness from 10 to 15 centimeters, depending on the material, regular and they weigh 150 to 250 kilograms.

Laboratory experiments have shown that the ping door gives the maximum of resistance to nitro-glycerine. If a quantity of this explosive is forced into the crack at the door jam and detonated, the main force of the explosion will still go into the vault and out into the room, because the edge of the door is perfectly smooth, giving the explosive no purchase.

The construction of such doors is one of the marvels of modern vault engineering. Entirely aside from the complicated multiple time-locks, its numerous powerful hydraulic rammer bolts, its intricate linear locking mechanism, the mechanical intricacies, such a door is a first-class piece of engineering. It seems to defy the eye to be a solid mass of steel, yet it consists of many layers. It is a composite in more than one sense.

To begin with, the outer layers, to mention only some of them, are ordinary strain resisting steel, reinforced concrete, sand-filled concrete, lead-lined against fire, heat resisting metal, to delay burglar entry, and so forth. Then, operating with the outside burner torch, tool resisting metals; at least one or often two layers consisting of the wire and folia of electric burglar alarm systems, and so on.

stacks (concrete and
attach lasting only a few
modern tanks

weight of almost two hundred thousand pounds.

But when we have glanced at these surprising facts and figures, the real wonder of the modern bank vault has only been hinted. It is a maxim with the builders of these strong rooms that a vault is, like a chain, as dependable as its weakest link or part. Thus the floor and sides of the vault must be capable of offering the same amount of resistance as these transverse chains.

They must be designed to foil any possible or conceivable method of assault. In addition, they must be constructed to resist fire and the tremendous heat likely to be developed when a great building comes into conflagration. In consideration of this risk, the roofs or tops of the big vaults of today must be even stronger than the floor, sides and front of door, for the roof must be additionally reinforced against the impact of falling bodies from above, in case of the collapse of a building through fire or earthquake.

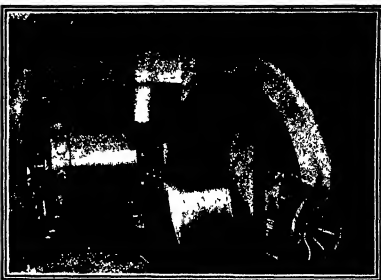
What kind of engineering is required for the achievement of such prodigious strength may be guessed when the dimensions of the really big bank vaults are under stood. For instance, in the new Federal Reserve Bank in New York there are three such vaults, one on top of the other. Each vault measures about 125 feet in depth and about 55 feet in average width. The bottom of the subterranean room rests on bedrock and the walls of the vaults are in part under the waters of the harbor. The main door of each of these vaults weighs about 90 tons and each of the three rooms has a second or emergency door, used for ventilation during business hours. The weight of each main door with its ventilators is in excess of 800 tons and the materials composing them are those already listed, steel, reinforcing metals, steel, asbestos rock, resisting metals, reinforced concrete, cables, alarm wires and the like. The vault doors of this bank are not of the plug type, an other and unique design having been employed to suit the needs of the building in which the vaults were placed.

In describing the structure of the walls, floor and roofs of our great vaults, it is to be remembered that no standard has yet been arrived at, that a number of engineering materials conflicting ideas about certain details of construction and that experiment is constantly being carried forward. Again, the chief difficulty in arriving at a perfected type of vault, and one that is not likely to be overcome in the future, is the matter of the constant development of tools useful in attacks on such constructions. Some months ago, in articles devoted to the struggle between the burglar and the maker of the safe, I recounted the fact that a race, like that between the gun maker and the builder of bulletproof armor, is in progress and has been for at least two generations. The same thing is true of the great bank vault. There has not been a successful burglary committed upon the vault of any great metropolitan bank in this country since 1878. Nevertheless, industry and the arts have gone ahead and perfected a number of tools which might at any time be employed by burglars of sufficient skill and daring to seize the opportunity. To this class belong the electric arc, the electric and pneumatic chisel, the electric drill and the oxy-acetylene torch in its latest development.

This last named tool is of especial merit and interest. I have previously written of its uses against the safe and vaults employed in rural or suburban banks and the defects met by manufacturers of strong

boxes for this clientele. It now appears that the cutters-burner tool, as it is preferably called by vault engineers, is a decided menace even to the great banks and their ponderous equipment, so that much reconnoitering and end-on experiments are in progress. To date nothing has been found that can be called a genuinely effective defense.

The effort to find metals which would foil the withering flames of the torch is not without its note of romance. When the oxy-acetylene cut-burner was first employed there was a great warpper after heat resisting metals and a number of compositions were produced which with stood the fiery tongue of the torch fairly well. (I mean to say compositions sufficiently in cost to be commercially useful.) When these discoveries were made the vault and safe-building world breathed easier again, but only for a short space. Then the inventors of the torch discovered that they could add liberally to the cutting and fusing power of their tool by adding the so-called fluxing material. Their purpose was, of course, to extend the industrial



Fifty-ton plug door of the vault in one of our great private banking houses. The floor is removable. The door is 36 inches thick.

that they would foil the burglar or hold him in check for days. Here, again, a considerable hinder was made for, with reinforced concrete doors give a much more resistance to the torch. It is comparatively true on the face of explosives and the high power tools with the highest type of burglar shield command under special circumstances. All this was brought out by laboratory experiment and especially by a series of tests made under the auspices of the Federal government at its artillery proving grounds two or three years ago. All kinds of vault materials and constructions were tried, and it was proved under very imaginable forms of strain and subjected to all manner of attacks. It was hoped to develop a material or method of construction that would resist the worst buffeting for several days. I believe I am overdoing it when I say that nothing of the sort was found and that the maximum period of resistance achieved was not more than a few hours.

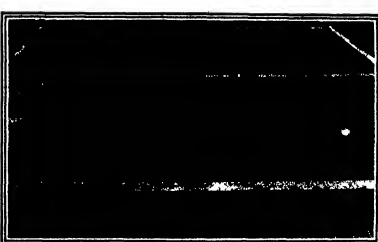
According to Mr. Frederick B. Holmes, the celebrated New York bank engineer, the ideal vault of today is, like the great doors, just described a composite. Its walls, floor and ceiling are constructed mainly of a special type of reinforced concrete, but many other materials figure prominently in its construction.

Concrete is reinforced with such slight materials as woven cables and lengths of steel rods. Again the concrete walls and floor are faced with iron and inward, so that if burglars should succeed in cutting a plug out of one of these thick walls, they would be unable either to pass the plug along of them into the vault or pull it out toward them. They would be forced to break it up into small chunks and then gradually make an aperture large enough to admit them. In addition, the best wall, floor and ceiling construction of vaults now calls for both linings and interlinings of various materials, very much like those employed in the great doors.

To make life way through such a lined, interlined, reinforced and unlined wall of concrete, usually from two to three feet thick, the burglar would need, first of all, to break away the outer layers of concrete with tools and explosives. He would then encounter the metal interlining, which he would be forced to attack with the torch. This should be his second great face great thickness of concrete, filled with reinforcing cables, rods and rods. Then he must again encounter a layer of various materials which would make more call for the torch. And, last but by no means least, he must have encountered the wires and cables of the alarm system before he had got well on his way. The vault builder, however, builds independently of the alarm. He builds a wall capable of turning back a burglar even if the alarm does not.

All this being understood, it must still be admitted that even vault walls of such monumental strength and intricate design might be broken in a few hours by burglars having the maximum of technical knowledge, the fullest equipment of the best tools, the best

(Continued on page 234)

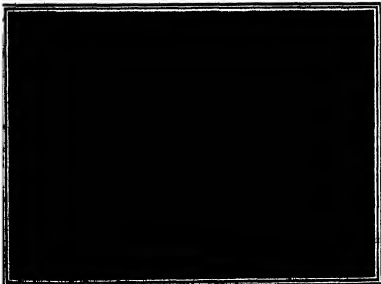


Ready to pour a great vault for a Federal Reserve Bank. Note the reinforcement rods for concrete interlaced with the cables for burglar alarm system.

use of the torch, but what they turned out proved to be a most formidable burglarious tool. The fluxing rod is a stick of steel. When the flame of the torch is applied to any metal for the purpose of cutting and heating, the end of the steel rod is placed at the tip of the flame and pushed the metal to be cut.

The very rapid oxidation of the soft steel rod raises the normal temperatures produced by the torch to enormous levels and the additional exothermic effect of the iron oxide, enables the operator of this device to cut and burn his way with tremendous rapidity through any material or combination of materials now known to practical use. The power of this tool and all the others must be taken into consideration when a vault is designed.

When it was first realized what the cutters-burner and rod would do to metals, many vault engineers turned their backs abruptly on everything but reinforced concrete as a proper material for vaults. Consequently some vaults were built in which this material alone was relied on, walls of extraordinary thickness being built in the hope



Technician working in the watch captain's room of the U. S. Treasury at Washington, D. C., which indicates operation of doors, time lock, and so on.

Some Curious Comestibles

Amazing Articles of Food that May be Unearthed in Odd Corners of American Cities

By L. Lodian



A grotesque food from the rivers of Manchuria—big dried shrimp, strong on hamon spits

NR of the oddest lotting of imported food stuffs in duty duty among the varieties of American cities is the big dried shrimp from the rivers of Manchuria. These creatures are sold in small bamboo—always a sign of oriental handling—and on seeking and steaming they enlarge vastly. Their food value is not high, as with a good many other delicacies, imported or domestic. Still there might be the germ of an idea in this method of preserving for the American fish trade. For example, the Far East usually preserves without salt, by just sun-drying the goods. A Westerner would be likely to insist that it can't be done but the lively example has been doing it successfully since the days of Confucius—and beyond. Selling they reason, has more demerits than merits. Salt attracts moisture and increases weight, causes the agency of thirst in warm climates, is destructive of some of the nutritive elements in food, and does not even completely prevent the development of bacterial life. Complete saltless desiccation largely overcomes these disadvantages. Once dry and kept dry, they can be no protection.

Automobile tourists who go in for concentrated provisions might find useful the compressed rice-marrow blocks imported from the trans-Pacific region. Its advantage over the raw grain is its rapid cooking, brought to a boil in five minutes. And there is no danger of burning as there is with the straight grain if not watched.

This vermicelli like rice product swells in boiling to about four times its dry diameter, when the shreds become of beautiful purple transparency, and print can be read through one. True, it requires a certain amount of practice in mouth gymnastics to negotiate these long elastic strings—but this is a source of actual fun to the novice.

Lovers of horse flesh—gastromancers that is to say, not sportsmen—can obtain pure all horse viands in more than a dozen different preserved forms, also, the fresh article. I have bought a few price lists of retail horse butchers the items read temptingly enough, if prejudice can be the excuse. Horse meat is remarkably fat free, one not "in the know" could not tell the difference between it and Chicago's finest.

The fattened and compressed, longer smoked and dried sausage is the most concentrated of all these pills of mystery. It keeps well for years owing to its dryness it can be carried long in the pocket. It is eaten as it is, or steamed, the latter is better. It is called sausage from the rural guards of the Central European States, who are wont to carry it as a sustaining emergency food. It may be ranked as one of the most fertilizing elements of nutrition in a condensed state extant.

The eating of horse meat is not in the German republics, in the Italian peninsula, in the Finnish countries, in France—and, surprisingly, everywhere else. Quantities of delectable garbage are imported into

New York from Delft, in the Netherlands, which is famed for this product. These tempting, tremulous colored jellies and blue-mangos made with it are almost exclusively derived in the first instance from the well stewed viscera of "old horses." There is a daily procession into the outskirts of Delft, representing a view of played-out work horses from neighboring States, especially the British Isles. Of course, all disease germs are steam-sterilized to destruction.

What look promulgating like dried oxalis are the slices of "muller" (untranslatable) from Arab the West. Walnut kernels are halved, threaded with almond, then dipped into a batter paste made of wheat flour mixed with palm oil—dried—in the Nile region, the local inf—syrup. The whole, after repeated dipping,

is squashed or flattened-out yellow "bananas" are a mystery. The outsider would never take them to be the red-tid-bit Turkish kajjar or caviar. The fish roe is cured whole and wild, then steeped in beer, hence the color and honeyed fragrance of the article.

The Paris blanchi-charbon (charcoal blanchi) has been known these two centuries or more, yet has only been imported to America the past half-century decade. It is not a medicated article any more than a whole-wheat blanchi would be no considered, but is a regular food product. It tastes just like the plain unwatered wheat blanchi. The color is an intense jet black—one third vegetable-charcoal flour to two-thirds whole-wheat flour. The color density of charcoal is such that it does not take much to swamp whatever shade may be associated with it.

Brillat de Savarin, the brainy jurist and gastronomist of the early nineteenth century, author of "The Physiology of the Human Stomach," which is translated into many languages, has written that it is never well to let others know what you have been eating, through the vehicle of breath odors, "whether vicious, or as a will of course," and he instances the usefulness in this connection of a couple of charcoal blanchis with a glass of water after meals.

But that is only one use. British medicine indicates their use in acidic conditions, in preventing belching, that disagreeable reminder of one's dinner, in forestalling the busy hour of the noble Briton, also as a vermifuge and a slight aperitif. In this case, as food and corrective combined, the charcoal blanchis continue to live their usefulness through the ages, and the marvel is that they are not made by American bakers. Decades after decades, the local importers of fine groceries have had to order them from Galle and British markets, with serious delay in delivery. Many products instance in this series of illustrated articles on the more futuristic foodstuffs of the alien colonies of America could be produced in our own factories, hence it is hoped that the descriptions will have a commercial value, as well as an interesting theme.

Take, for instance, the remarkable marmalades. There are two kinds, the Turks use the chosen Damascus white rose, the Orientals the large red rose corresponding to our American beauty. The vehicle of preservation may be virgin honey, cream, or China, or the date or palm or nut syrup. It varies from the Bosphorus to the Nile delta. All this import of the luscious marmalade is not so much as the displaced by American preserve manufacturers and our florists, who annually have in the aggregate tons of raw petals that go to waste from day-old stores, could thus dispose of their discarded.

The fragrance of the rose marmalade is not that of the freshly plucked rose, but resembles the modified fragrance from a blossom a year or two old. It comes in sealed containers or corks holding approximately five pounds, which on opening are found to be

FROM the huge sea slug of the Orient, pictured in all his repulsiveness projecting his bulk into the upper corner of this box, through all the other items which he illustrates and describes, down to the jester sausage of horse-meat that droops its graceful shape across the adjacent page, and down to the last of the foreign foods that he has sampled, both in their native surroundings and as domesticated, more or less, by the American dealer who caters to the tastes of our foreign colonies. We think he makes his story quite as interesting as his revelations of what the other half eats usually are.—THE EDITOR.

is simply sun-dried to the proper degree.

This singular looking nut-and-fruit glue cake is always obtainable among the Arabic-speaking colonies of urban communities in the United States. It is a choler moriel, the nut imparting part of its delicate flavor to its protecting succulent covering. It is dry to handle, having been flavored in the sun adhesive rose flour which, unlike wheat flour, becomes glutinous only by heating with moisture.

The well-known complete cessation of strife in the Turkish state is reflected in the return to American markets of much Near-East foodstuffs. The peculiar little one-pound rose-colored sugar canes of the harem (retained plain sugar with rose fragrance) affected by the fair tannin of the sugar for their tiny cups of coffee or tea—this is perhaps the daintiest sugar reaching our shores. It has the inconvenience of having to be broken into pieces with a sharp rap from the sugar tongs, to prevent a fragment as required for use.

Those post-skin containers full-up—apparently—at

sometimes little more than two-thirds full. This is due to the contents' having been again sterilized in steam at a minimum of heat, after the sealing of the container. It is purposely never filled, so as to allow for over-expansion of the contents and thus prevent fracture of the container. Also, the rose fragrance is thus retained in almost all its exquisiteness. For purity, taste, etc., the rose confection is added cold at table, cooling beforehand would dissipate the fragrance. The container itself figures at table until used up.

The unique nut peach of mid-Asiatic countries was illustrated on these pages (December 15, 1919). A western peach-growing specialist obtained specimens of the fruit, planted some of the stones, and now reports that the plants are growing vigorously. In a few years we may expect to see the mid-Asiatic American nut peach on our markets. This is a freestone peach, always to be preferred in the climatic variety with a smooth skin like that of an apple or plum, a sweet almond like edible kernel, and an exquisite taste which renders it for fruity fragrance, different from any other peach in the world. A whiff from a freshly opened crate is a precious memory. From fruit stores specializing in foreign products, this peach is always obtainable in season.

This time we illustrate another fruit marvel of the central Asiatic lands—the stone-hard *syzygium* mandarin. This is odorless, non-sticky, yet grows. It can be carried home in the pocket. It has, like our rock candy, only an intensely sweet taste. The sugar crystals melt right inside the fruit on maturity, we show one halved, revealing the white sugar granules. This is the only known fruit that can be used, direct, as a sweetener. The effect is the same as through one used ordinary refined sugar, there is no fruit or syrupy taste imparted in the drink, only the effect is slower, and the tough date must be broken in two to facilitate nature.

This wild growing date is, unfortunately, one of the unseasonable climate variety. The pits are sharply pointed in three and are used by the natives as small swords or nails. The slit that forms so prominent a feature of the outside contour of the ordinary date-stone is here undetectable. It occurs only as an almost negligible cavity in the center of the slit pit, containing the filament-like germ.

These dates are crushed by the ton in the countries of origin, on maturity, the liquor is sun-dried in hollow pans to a hard cake (there is no sugar to cure for) forming the cheap poor date-sugar of Oriental markets, as Cairo, Iraq, Singapore, Calcutta, and across

of other eastern importations. These lands have a diversity of sugar, with the quantity produced in the occasional year of cane and beet sugar. In fact, the annual production of sugars other than beet and cane variety is greater in excess of the tonnage of those super-civilized varieties, being computed at more than

20 million metric tons. One of the big sugar head quarters in Wall Street has a permanent exhibit of these other-worldly sugars.

The wild dates are always obtainable at Oriental importers in the prominent American cities. They can be grown in our south-western States, and have the double ability that they can be sold as fruit fresh or dried, or as a direct sweetener. I first came to know them north of Tombaugh a quarter of a century ago, but they are not known to American date specialists, and even the Foreign Plants Section of the Department of Agriculture never heard of them.

The tropical American cone sugar kilogram—just the sweetest un-esterified unesterified sugar today in the Latin American hemisphere at five cents per kilogram (2.2 pounds), which is certainly below the cost of sugar in our markets. This sugar, dark brown product is esteemed by the South Americans for the use of their strong coffee. It imparts a delectable smooth savor which refined sugar does not give.

The refined white-sugar cones of the Central American republics are kept out by the tariff with its American valuation, in spite of the favorable exchange in Europe this article is retail at about a cent at its pound.

Slugs as an article of diet do not appear in the western world, yet the native *Bolbina* roach, here as a tit-bit. A tree slug, corresponding in size to the common back and slug of American garbage heaps, is chopped out of the decayed wood in which it lives, and swallowed alive and whole, with great gusto—it is so adored at its best, thus. Of course, on abstract principles this is far wiser than eating our own flesh of eating chains and covers—it all depends upon what you are used to.

The Oriental does not bother with the small slug he prefers the same in this field. As a slug is his piece de resistance. The slug life is a big one. Far Eastern importers in America (this is so) without a large variety of them. No slug ranges in size from a goose-neck to those, the size of your hand, or even bigger. The prevailing color of the dried article, the only form in which they are not common, is a dingy gray. In fact, they look almost like the little round droppings of mouse with one may, often made at the base of a leaf wall going up. And they are just as hard! Yet when a slug is crushed, they go over into a delectable gelatinous mass and make an unending broth that has merited their introduction into some of the Australian hospitals, as a bulimic for convalescents.

One of the largest sea slugs is illustrated here. It is dried in the size of a plum, yet measuring about doubles its size. In its delectable state it has a feeble gelatinous odor, not unpleasant and the color is at most black. Contrary to universal custom in eating covering subjects destined for dining for food use, these sea slugs have the viscous running through an incision running the length of the back which also enables them to be upturned quickly and sun-dried. As they dry they automatically close up again leaving a visible slit on the under side, the rudimentary feet are plainly discernible.

Bread Diseases

There are several changes which take place in bread which are due to the presence of unknown organisms, and which may seriously be called bread diseases.

The first of these is a variety the bread to such a small extent that it can be pulled out into threads. This bread disease is most common. The crumb becomes sticky

and colored. The most characteristic symptom is that the bread, on being broken, can be pulled out into fine threads. The bread assumes quite a disagreeable odor and taste. The nasty acid odor can be detected in baked loaves where the disease has been prevented, many weeks after it was first noticed. The particular bacteria which bring about this disease belong to the potato bacilli group and possess one characteristic in common, that they produce spores which are extremely resistant, being able to withstand the heat of the boiling oven. The bacteria grow best at a temperature of 20 to 28 degrees Centigrade. The first method of the sticky mass in the bread, which can be pulled out into long threads is due to the swelling of the bacteria's membranes.

Bread becomes blood-colored due to another bacillus. Outwardly, the appearance of the bread is the same, but when it is cut open red streaks are seen in the crumb. This disease and the one described previously are most troublesome to the baker, because once the disease sets in, it is an extremely difficult matter to eradicate it. The utmost cleanliness must be observed to prevent the recurrence of these diseases and to destroy them once they do set in.

Bread also has a tendency to become moldy for it is the first-rate medium for the development and growth of molds. Various molds can produce various colors in the bread. For example, the black molder produces a white coloration, *aspergillus glaucus* bluish green coloration, *ergosterium* reddish and black spots may also be produced by molds. Neither the molds themselves nor the decomposition products which are brought about by their presence in the bread are injurious to the health but they make the bread unwholesome in appearance and unpalatable.

There are various precautions to be followed in order to avoid the development of these diseases in bread. A moderate high temperature is favorable for the growth of the bacteria. Warm bread should be cooled quickly after baking. The moisture in the bread is also of importance in this respect. Moisture promotes the growth of the bacilli, and hence a poorly baked bread in which the moisture content is high will be more apt to be attacked by the germs than a well baked bread. The air in the room in which the bread is kept must not be moist. Well baked bread, cooled as quickly as possible and kept in an airy dry and not too warm room will not be subject to these diseases. Of course, the main prerequisite is painstaking cleanliness in the baking operation and in the handling of the bread.

Tests of Trees Made from Reclaimed Rubber
Bureau of Standards has placed an order with

one of the rubber companies for the making of fifty tree latex samples containing of reclaimed rubber in the blends. After identification these trees are to be tested in the laboratory and also on trucks of the Post Office Department over four different types of roads, so that the relative wear of the different compounds can be determined.



Left: Compressed almond meal from China. Center: Two black olives from Europe—a popular food and one a medicine. Right: Wild dates of the immediate climate variety from India.

Also, stimulating plants of sugar but no syrup

Three more novel food products from all parts of Exports

With the Men Who Fly—I

Recent Achievements in Engines,

Practical Aviation, Such as the Coast-to-Coast Flight, Better and Arrangements for Night Flying

By Alexander Klemm

Lecturer on Aeronautics, New York University

RECENT progress in aeronautics has been almost bewildering in its extent and variety. The world's speed record now stands at nearly 240 miles per hour. A single engine now reverses and a non-stop coast-to-coast flight is likewise in the credit of the American Air Service. Engines on full power tests are now expected to run 24 hours continuously. Gliders remain aloft for many hours with nothing but air currents and the skill of pilots to sustain them. Helicopters have risen vertically, hovered over a given point, made complete circuits in horizontal flight. Airplanes have been attached to dirigibles while, both types of aircraft were in night flight. Steel is displacing wood in the construction of airplanes. Pistonless planes carry out complicated evolutions. The science of aerodynamics has progressed to the actual calculation of the lifting capacity of curved wing sections, and its art to the design of thick, high wings providing relatively immense depths of structure for sustaining loads, while maintaining all the efficiency of the thin wings we have been accustomed to thus far. Flaps at the rear edge, as well as functionless, deformed tips in wings have at least doubled their lifting capacity, thus facilitating slow landings.

But out of all this activity a number of things emerge very definitely, and three unmistakable lines of achievement in practical aviation appear to us.

First, the enormous increase in the endurance and reliability of both planes and motors, as shown by the coast-to-coast flight and the famous Atlantic trip. Next the very rapid approach of night flying. Third, the advent of the glider, of which the motorized glider or low powered airplane is the direct sequel.

The Coast-to-Coast Flight and its Lessons

The coast-to-coast flight is undoubtedly one of the most dramatic achievements of modern aviation. The interest and enthusiasm which it aroused were country wide, and almost as great as that following the famous flight of the "Spirit of St. Louis" across the Atlantic. But this flight has far more practical significance than a new stunt or record. It is a landmark in the development of plane reliability, and worse this, has set in a real chronology of achievement.

On October 8 and 9, 1925, Lieutenants John A. Muroy and Oakley K. Gribble, of the Army Air Service, flying over Rockwell Field, San Diego, Calif., in a Fokker "V" plane (labeled the "F-2" by the Army), equipped with the famous Liberty motor, established an endurance record of 35 hours and 19 minutes continuous flight. On November 3 and 4 the same men in the same plane flew from Rockwell Field, crossed the Rockies in spite of violent storms and came down at Scotch Field, Fort Benjamin Harrison, Ind., after covering an airless distance of approximately 2000 miles, in a non-stop flight of 27 hours 56 minutes. Their failure to reach the Atlantic was due to a leaky radiator, which caused enormous expenses as pouring cold water and condensed milk into the radiator. The engine did not recede. Early in April of the same year, the same persistent pilots beat their own endurance records by flying over Mexico Field, Dayton, Ohio, for 30 hours 50 minutes, when they were forced to land by a cracked water jacket.

Then they devoted their energies in preparation for a second attempt to make a non-stop coast-to-coast flight, backed by the skilled efforts of Army engineers and mechanics, taking care to correct the engine, water pump and motor. The new historic "F-2" is worth careful study. It is a huge unit—monoplane of 860 square feet of wing area, standing right on top of the fuselage and nothing remains of the numerous struts and wires which are generally associated with the trailing of an airplane. The wing is 40 feet in thickness and spans from front to rear so that it has a maximum strength near the fuselage where also the maximum bending stresses occur. The entire covering is of very thin veneer, most skillfully applied, instead of the usual linen. The body of fuselage laminated

of welded steel tubing. One of the most noteworthy features is the position of the pilot's seat right beside the engine. All the engine controls are thus very short, and the slightest defect in the engine or the gas, oil or water systems is immediately noticeable.

Although the machine was originally designed to carry a pilot and eight passengers, very few alterations were

AVIATION is forging ahead from such spectacular achievements as the huge dirigibles and their mooring masts of the type here shown, as well as the low low-powered airplanes and gliders, there has of late been a steady succession of remarkable improvements and developments in flying craft. We have asked Mr. Alexander Klemm, the well-known authority on aviation, to write for us the outstanding developments in the aeronautical world, and the accompanying article is the result. Because of its length we have found it necessary to post this article in two parts. The second part will appear in our November issue.—THE EDITOR

made for the coast-to-coast flight, beyond installing more fuel tanks, bringing the total gasoline capacity up to 1.5 gallons, and installing another set of engine and flying controls in the cabin so that the pilots could more conveniently relieve each other. Precautions taken to fore the final flight were many, but not in the direction of increasing the strength of the plane or changing its flying qualities. Learning from previous experience, the pilots took a quantity of oil and fuel compound which could be injected under pressure into the cooling system, took a spare battery, an extra gas gauge, and reinforced all the pipe lines. By cutting

the enormous speeds relative to all other methods of transportation, it is not negligible. When fully loaded with its 720 gallons of gasoline for the coast-to-coast flight, the machine weighed a few hundred pounds above five tons.

Leaving Rockwell Field, L. I., on May 2 at noon, Muroy and Kelly reached Rockwell Field, San Diego, on the following afternoon after a non-stop flight of 26 hours 50 minutes, and covering an airless distance of 2000 miles. According to the pilot's own estimates the average speed maintained was 80 1/2 miles and the Liberty motor functioned steadily at 80 per cent of its full 400 horsepower.

In the initial stages of the flight the plane was greatly overloaded, and an altitude of only 1500 feet could be maintained over Long Island, New York City and New Jersey, although it remained under perfect control. At the end of the first half hour, the battery regulator gave trouble and only after a hour's hard work by Kelly saved the trip from failure in its initial stages. Reaching Indianapolis, darkness overtook the fliers, and, between Indianapolis and Tuncumcr Travelling in New England, they were not equipped with the means to get their exact bearings in northern Arizona, they now flew and had the most exciting time of what they called a handrun flight. They passed over Arizona, forests and canyons, and in spite of treacherous air currents they negotiated a path between the walls of one deep canyon. They welcomed the hangars of Rockwell Field with relief, nevertheless, and came down in perfect condition, although neither flier had slept during the entire trip. The men who were not actually in the wheel always found plenty to do in watching planes and instruments, and in keeping the log. The sole effect of the long flight was that the fliers were a little difficult in hearing induced by the steady roar of the motor. People had lined the whole route, Pittsburgh, Dayton, Indianapolis, Tuncumcr and Wickburg, Arizona, being the main points passed on a remarkably correct course. One hundred thousand people welcomed the pilots at San Diego, and telegrams, including one from President Harding, poured in with congratulations.

The lessons of the flight are most important. Apparently the airplane is now ready for commercial air transportation. In all this arduous work, under all sorts of flying conditions, in unexpected changes, the "F-2" showed no signs whatsoever of structural weakness, lack of control or instability. It flew as smoothly as an experienced pilot would seem to be as no insuperable difficulties in navigation, whether by day or by night—although the pilot state they would have followed the same marking tones and other landmarks, particularly at night. The economy of the airplane is not so disappointing, and it is evident that a commercial plane can be overloaded to a large extent without serious consequences—a very important factor.

Extraordinary Advances in Engine Endurances

Analyzing the difficulties experienced in all of the successful efforts of the past, we see that the engine in the engine, or more broadly in the power plant as a whole, is the key to the problem.

It is true that the Liberty engine functions with great regularity. But it did crack a water jacket. It is true that on the coast-to-coast flight, the installation stood up well. But still, the engine, the water and water system have to be watched with minute care and apparently give all the trouble. Here comes to be the crux of the problem—how to make the engine and its installation. The installation of pipe lines, the adjustment of the engine, all purely mechanical problems, requiring a knowledge of aerodynamics, must engage the attention of airplane designers, engine designers and power plant engineers. A fool-proof and absolutely reliable radiator may advance practical aviation a great deal more than the most refined improvement in wing design. But the engine motor was far built some six years ago, and, as the following remarks will show, its design is advancing most rapidly from the point of view of its efficiency. Its parts of the vastly harder alloys, automatic-engine radiator is an aid to which airplane practice should gradually converge.

Constructive, Bureau of Aeronautics

Primitive seaplane constructed by the Cox-Klemin organization for use as a scout with submarine. Measures 18 feet over all, and weighs 650 pounds

out the cabin door and converting it into a sliding one, they are the main in the entire possibility of attaching out almost his entire body into the air for inspection purposes.

The maximum speed of this plane on official Army tests is 110 miles per hour. The airplane is often accused of being uneconomical, or consuming great power. But it is not. It is a very light plane, weighing 650 pounds empty, carries a useful load of 900 pounds and covers a flight range of 45 hours, carrying over 2000 pounds of what commercial aviators call "pay load"—mail, passengers or freight—which, considering

It is only very rarely now that a new principle is introduced into the design of the internal combustion engine, or even a radical modification in its mechanical construction. Progress today is improvement step by step, there is continual and steady development in the air or on the test block, there is better use of material; but there is a more correct application of well-known mechanical principles. A surprisingly large amount of such gradual development work is being done, however, and while the power of the airplane engine is being increased, it is a given weight, it is, above all else, progressing in the direction of greater reliability. It might be thought at first that greater reliability and increase in power are antagonistic; but to make an engine more reliable, the weight has to be increased. But the contrary is true. The same changes which make the engine lighter also improve its endurance.

The general character of such changes is very simple, however important. Long crankshafts and crankpins are inherently heavy, flexible and weak. Therefore the tendency is now to bring the cylinders close together. The short crankshafts and cranks are stiff, light and rugged. To keep down the number of parts increases dependability. The tendency now is to keep down the number of cylinders and increase the power of each, thus keeping down the number of parts and also increasing the weight for a given power. Duralumin is as strong as mild steel and only weighs one-third as much, and is therefore being largely introduced into connecting rods and pistons.

With better cooling and better design for the admission and exhaust of gas, it is possible to drive engines much faster and to use higher compression ratios. In the old Liberty motor, which was a gas engine, the weight and substance has been in the lack of rigidity, which has caused frequent water jacket failures, as in one of the Harcourt and Kelly flying machine. A Liberty engine built by the Navy are now built with two $\frac{1}{2}$ -in. liner aluminum blocks, reducing the oil system of twelve separate cylinders. The result of this is a more reliable engine than any other of its kind. The Curtiss "D-12," one of the most successful engines of the day, develops between 375 and 400 horsepower and weighs only 670 pounds. A Liberty motor averages about 72 hours in the air before requiring a complete overhaul, and the Curtiss "D-12" stands up to continuous 100-hour runs, without a sign of failure or deterioration.

Not only is reliability of the engine important from the point of view of safety in flight, but the cost of its upkeep is perhaps one of the determining factors in the possibility of aviation on a commercial basis. It is estimated, for instance, that it takes 300 hours to overhaul a Liberty after its average run of 72 hours in the air. The cost works out at \$0.30 per flying hour of the engine.

Other engines recently built, and test quite as well as the Liberty, are fitted as regards low weight per horsepower, fortunately show even more results as regards reliability. Thus all engines purchased by the Navy must stand an endurance test of 200 hours at full power. And particular notice has been shown truly remarkable power of endurance. This is the "B-4," built by the Curtiss Wright Aeronautical Corporation. It is an eight cylinder motor of approximately 300 horsepower, which, when tested by the Navy Department, ran at full power for 278 hours. During the test, it would have covered a normal cruising speed maintained by the Navy airplane a flight distance of approximately 60,000 miles, or two and a half times around the equator. The high-grade automobile travels 6000 miles per annum. The new engine could drive such an automobile for nine years at 100 miles per hour without showing any weakness or giving any trouble.

Certainly there is every reason to be gratified by these figures. One can only hope that the "B-4" will be put into a plane as reliable as the "B-4" is to that all pipe lines and auxiliary devices of the engine function reliably. The possibility of trouble in flight will be as remote as that of trouble on a giant transatlantic liner.

Possible Use of the Diesel Principle

While engine endurance has increased by improved design along conventional lines, there is possibly a radically different direction in which airplane engines may still be developed. The Navy Department in the United States, and the famous inventor Dr. Hugo Junkers, in Germany, are experimenting with high-speed internal combustion engines based on the Diesel or semi-Diesel principle. The well-known principle of the Diesel engine is the compression of air in pressure in the neighborhood of 500 pounds per square inch, and admission of this air to the combustion chamber at the end of the compression stroke simultaneously with the injection of liquid fuel. As the temperature of the mixture in this case above the ignition temperature of the

are conceivable. A combination, for instance, which readily occurs to the designer is of two firing chambers working at opposite ends of a larger space which might constitute the compressor. It has also been suggested that the air might be compressed inside the combustion chamber, a hot bulb employed, and liquid fuel injected at the end of the compression stroke. It is also possible that rotary air compressors revolving at very high speed might well be utilized—a principle already successfully employed in airplane practice in supercharging the engine with oxygen.

There is no doubt that the application of this principle to the airplane engine is fraught with difficulties, but the attainment of such high speeds and efficiency and the possibility of using cheaper fuel, are well worth while. There is undoubtedly here a vast field for invention, research and engineering skill.

Progress Toward Night Flying

The numerous hindrance to the commercial utilization of the airplane has been the lack of possibility of flying at night. It is only when the airplane can give a continuous and easy service that it will surpass such means of transportation as the automobile. The very best power and unit thrust serving all the needs of the world is the United States. No the problem of night flying is now engaging universal attention in the United States.

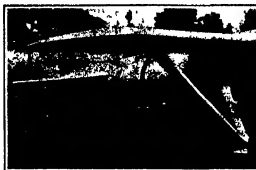
Preparations are now being made on the London-Panama route for night flying, and aerial highways and other illuminating devices are available in the United States, between New York, London, Terminal and Vienna, the point where the route runs the narrow English Channel and the Atlantic Ocean. The United States has also the "Bogotá River of Continental Airways."

In the United States an aerial highhouse is in operation at Washington, Virginia, and the United States Air Mail Service of the Post Office Department is preparing for night flying to begin at about this time. According to a statement by Postmaster General Nease, there will then be a continuous service between New York and San Francisco, which will cover the interval of 3000 miles in 28 hours. Millions of people in the Middle West will nightly witness an artificial aurora here, visible fully 10 miles from its source. This will be created by great aerial lights at the five major lights in Chicago, Iowa City, Omaha, North Platte and Cheyenne. Smaller lights, with a visibility of only 30 miles, will be placed at emergency lights every 25 miles along the route. Aerial search beams every three miles will be used as well as ground indicators. Aerial lights to mark buildings and other obstacles at landing fields, complete the artificial aurora.

A year of these extraordinarily careful preparations and the natural advantages of the very level country between "Chicago and San Francisco" have been made this night light of the service almost as safe as day flying. Certainly, Harcourt and Kelly would have been thankful for even a small number of such devices installed along the route. There is no doubt that with these wonderful adjuncts, night flying is entirely practicable and will ultimately be an important part of our aviation by night. If the Air Mail is successful in maintaining its night flying schedule, the world will be one of the historic landmarks in the history of aviation.

It is interesting to see how all-embracing the airplane is in its calls on other branches of engineering and industry. In order to be able to fly at night, the airplane and other night light, develops a new and fascinating field of illuminating engineering is rapidly developing. Some of these developments are of great importance. The very large Air Mail highhouses are somewhat different from the shore highhouses which are used for lighting. To get the most out of these highhouses their electrical lights of 100,000,000 candlepower on top of their towers, throwing a beam of light 3000 feet above the horizon and making the light visible for 200 miles every minute. These lights, on grounds of expense, will be operated only when planes are expected. The new method of lighting the air is being developed every 25 miles along the route, will, on the contrary operate continuously. They are constructed on different principles. They have been developed by a private company which is a part of an international corporation.

(Continued on page 224)



Nieuport-Delage racing monoplane, showing the present-day tendency to increase the use of wire and cable.

fuel no ignition system is required; the reform it follows that ignition systems and complicated structures may readily be dispensed with. The Diesel engine is thus secured.

The Diesel or semi-Diesel engine has a combustion cycle of greater efficiency than the usual internal combustion engine, and permits the use of a heavier and less expensive fuel than gasoline. However, the difficulty in applying the Diesel principle to an airplane, notwithstanding its simplicity and efficiency, is the large amount of compressed air which has to be supplied to maintain the engine cycle.

This involves the use of bulky and heavy compressors. Another difficulty is that the Diesel is essentially a slow engine, because the liquid fuel will not burn efficiently with a fast running engine. Accordingly, the lightest Diesel engine ever built weighs about 80 pounds per horsepower, and this is a long way from the two pounds per horsepower of the airplane engine. It is possible that the semi-Diesel principle is a more promising line of attack, whereas a hot bulb placed inside the combustion chamber is used to secure combustion at



Curtiss 'B-4' biplane, showing the present-day tendency to increase the use of wire and cable.

low pressures and the air is not compressed to pressures above 200 or 300 pounds per square inch so that air compression is less of a difficulty. Besides the problem of retaining down the temperature and increasing the speed of revolution without cutting down efficiency owing to slow combustion of the liquid fuel, there is still the difficulty in making built on the Diesel principle, but of small power, that valves for the admission of the liquid fuel would be extremely small and likely to clog.

Both the Navy's experiments and those of Junkers are at too early a stage for much information to be available, but the objective is that both lines of work are on the semi-Diesel principle, with low compression difficulties to overcome. Many types of this principle

Our Point of View

The Return of the Apprentice

ATHOUGH there is a growing doubt as to whether the good old days were quite as good as we have been taught to believe, there are undoubtedly some reasons to which they surpassed the times in which we live. If way of industry, consider the day of the old apprenticeship system and the superb master workmen who grew out of it. Living in the home of the employer, bound to him for a period of years, he had commenced with the simplest elements of his trade and was required to become thoroughly efficient in one detail of his training before another could be taken up. After a period of instruction, frequently lasting for seven years, he graduated as a highly accomplished workman, expert in every branch of his trade. Of the ability of these workmen of medieval times we have abundant evidence in the superb masterpieces that have survived to the present day.

Labor saving machinery and our modern fondness for specialization, in any nothing of the tremendous range of modern competition, have obliterated the indoctrinated apprentice, and with him of course has gone also the highly skilled and versatile craftsman. Today the ranks of so-called skilled labor are largely filled up with labor which calls itself skilled, but is altogether unskilled, and, as a direct consequence, not only does the grade of work turned out compare unfavorably with that of earlier days, but the unstable and unreliable mechanics tend greatly to diminish the output and add immeasurably to its cost.

Obviously, the modern loss in the reconstruction as far as may be, of the best features of the old apprenticeship system, shortening the period of training and adjusting the system to the conditions of our modern industry. Presumably it is known to few outside the field involved, that a most earnest and successful effort is now being made in the building trades to do this very thing, and with a view to bringing this vital movement to the notice of the public Mr. W. H. Clark, recently invited a large company of editors of this city to meet the representatives both of employers and of labor at a luncheon, and learn from them what has been done.

The situation of today as outlined by Mr. H. L. Penner, President of the Apprenticeship Commission, is that in nearly all of the skilled trades the supply of skilled mechanics is running at a low level, and more than 60 per cent as many available in many trades as there were ten years ago. Some skilled mechanics, it is true come over from Europe, but for twenty five years past the number has been steadily declining. Hence we must depend upon our own efforts, and educate our American boys for the skilled trades. The Commission has put in operation a system which aims to give the apprentice a thorough and well rounded course of training, the bulk of the instruction being given in the shop or on the job. It has been arranged that while the young man is learning "how" to do the job, he shall learn "why" by attending some form of training school. In this respect, the Commission has met with the enthusiastic support and cooperation of the Board of Education, and the various trade associations and teachers have been supplied courses of study have been outlined and have been adopted, and ample funds have been provided. It appears well for the solution of this great problem, that not only the employers, but the labor organizations also are giving the new system their hearty support. Incidentally, Mr. Penner drew attention to the fact, that under the present method, American boys are being brought up to better citizenship, since the seeds of radicalism and discontent can find no congenial soil among the ranks of highly successful and efficient craftsmen.

Speaking for the Chairman of the Board of Education, Mr. Eugene Gilkey drew attention to what he called "The recent democratization of higher education" which makes possible for every citizen a high

type of intellectual training. The humble parent would like to see his son in the professions, yet, now that the trend is toward more than the past, there is a real risk to escape the white collar bridge. So the school was called in to develop a vocational training that should turn out in a month a bricklayer or a plumber. This has been regulated, and the new situation is now being found to give the apprentice his intellectual equipment in the classroom, while he is acquiring experience and skill during his day's labor on the job.

Crewless Airplanes

THE crewless airplane, as its name implies, is down without a pilot. Its control, as to height and direction, is effected by means of radio impulses sent from some point outside of itself. So far as its control is concerned, the machine is in the same class as the radio-controlled torpedo and it is subjected to somewhat the same limitations. It will be remembered that the earlier attempts to produce a radio-controlled torpedo called for such control to be made from the shore and, as we pointed out in those earlier days of experimentation, the range of the torpedo was limited by the range of vision and also by the fact that it would be impossible accurately to steer the torpedo if it moved very far from a straight line drawn from the observer to the target. The same inherent conditions of the problem would render it difficult for an observer placed in some fixed and distant position to direct a crewless airplane against a ship at sea, or any definite object such as a machine gun nest or a battery. In fact, the problem was further complicated in the case of the airplane, by the fact that, since it is in the air and the observer on the ground, he can never be certain, as he straightens out the air plane for the final drive, that it is pointed directly at its target—consequently, it will probably strike short of or beyond the target.

Hence, to direct by radio a torpedo, a crewless torpedo boat, or a crewless airplane, with sufficient accuracy to make a direct hit on a definite target, it is necessary that the radio control be exercised by a pilot airplane which flies above the torpedo, and above and behind the crewless airplane. Put-in shooting is never possible, that is to say it is rarely worth the expenditure of time and materials. The crewless airplane, for example, is loaded with a heavy charge of TNT and directed from another machine, would be a deadly weapon for the destruction of bridges, ammunition dumps and a variety of other military objectives, but to send these machines into the air, to direct them there, unattended, over the enemy terrain, and cause them to dive for the final blow, would be very hazardous work. The same amount of high explosive directed from heavy artillery would, in our opinion, do much more effective work. The radio-controlled torpedo is intended to be steered from the air, and we presume nothing less than this is contemplated in the use of the crewless airplane.

Prevention of Automobile Accidents

A REPORT made at the last annual meeting of the National Highway Traffic Association opens with the statement that during last year 14,000 lives were lost in this country in automobile accidents. The present registration shows that there are in the United States 12,000,000 vehicles, and the manufacturers estimate that the increase this year will be 8,000,000 additional. The report says that the risk to safety lies in the fact that 60 per cent of these vehicles are considered to be on our roads. Fourteen recommendations are made by the Committee, all designed to reduce the ghastly slaughter which is now going on, and which, unless something is done to check it, will continue to increase.

The more important recommendations come under four heads, first, to secure good designs for new roads, second, to promote adequate improvement of old roads;

third, to insist upon reconstruction of existing roads at places which will prove especially dangerous, such, for instance, as grade crossings and approaches to bridges, and lastly, to improve the location of the center line on dangerous curves and elevations. Particularly urgent is the call for standard practice throughout the country in respect to the location of danger signals, the elevation and banking of curves, and the widening of the roadway with regulation of traffic on curves. On the completion of transcontinental routes there will be an increase of interstate traffic, and when a driver passes into a new section of the country, where the regulations, signal posts, etc., differ from those in his own State, he is liable, without intending it, to break local State rules, thereby becoming a danger both to himself and others. Hence, the need for standardized rules, and so far as possible, standardized constructions from one end of the country to the other.

Perhaps the most important recommendations of all are those which have to do with curves on roadways and the approaches to them, and particularly the suggestion that there should be cleared away whenever possible, all stone walls, underbrush, trees, banks, etc., on the inner side of the approach, so as to make it possible to obtain a sight of the other approach at a distance from the curve of at least 500 feet. Furthermore, the curve should be banked so as to protect against skidding and to assist the driver in keeping within the limits of his own half of the road. It is recommended that this precaution vary from holding for a three-degree curve to one per cent of width for curves of twenty degrees or sharper. Furthermore, on all curves of more than four degrees the pavement should be widened on the inside one-half foot for each one-degree increase in curvature, and the widening and banking should start at a minimum of 50 feet before reaching the beginning of the curve. Another important recommendation is that a line about four inches in width should be painted on the center line of the pavement on all curves. Furthermore, notification of all sharp and dangerous curves should be given, by sign, about 400 feet from each end. Another recommendation, aimed at one of the most dangerous practices of the inexperienced or careless driver, is that the traffic code should contain a law to the effect that the slightest use of a motor vehicle, if going in the same direction as a curve either horizontal or vertical, where the unobstructed line of vision is less than 500 feet, should be made a misdemeanor. Another important provision for increasing the safety of the road is that all advertising signs except those erected by direction or permission of the highway officials.

The adoption of these suggestions of the National Highway Traffic Association would go far to cut down the annual toll of fatalities, and we recommend them to the careful study of the various State highway officials and all owners of motor cars. They would impose no hardship on the motor-car owner, at the same time the safety of travel on our public highways would be assured.

Limits of Size of Ships

AT THE meeting of the International Navigation Congress held last month in London, there were two subjects of major importance, one of which was directly related to each other, which were dealt with in no less than seventeen reports. The two outstanding questions were the present and future size of ships and the nature and cost of the dock accommodations which, if provided, would enable our laymen who may read these reports will come to the conclusion that the factor which will control the size of future ships is the rapidly growing cost of the dock to which it is directed, and not the cost of the ship itself, which is at the ports or on the water.

What is not for the difficulty, risk, and cost of handling and berthing the giant liners of today at their

Our Point of View

terminal point we see no reason why the dimensions of future liners should not continue to increase. Contrary to the popular supposition, it is a fact that during such a busy summer season as this of 1923, ships like the *Mauretania* and *Imperator* are loaded to capacity with their heavy ordered cargoes, are able to show a satisfactory profit. The trip to Europe, despite its cost, reveals no signs of losing its popularity, for trans-Atlantic travel is growing steadily. The enormous popularity of the trip to Europe has produced the luxury of a trip to Europe and travel on the continent within the reach of a large class of people, who before the war would have looked upon it as a great extravagance. So long as there are sufficient travelers who are willing to pay from \$300 to \$500 for their trip, the operation of large ships will be a profitable and attractive business.

We well remember the sensation which was produced when Dr. White, the Chief Constructor of the British Navy, was asked to estimate the cost of building upon open water. At that time the largest vessels were the "City of Paris" and the "City of New York," each 500 feet in length. Today, in the "Leviathan" and the "Majestic," the length has been increased to 600 feet, and he would be a bold prophet who affirmed that this was the absolute limit. Thus, among the papers read at the London Conference, was one from the Chief Engineer, Mr. Cyril Kirkpatrick, Engineer-in-Chief of the Port of London Authority, considers that vessels over 1000 tons will be built, and recommends that the "Leviathan" and "Majestic" be enlarged. The largest ships of the future should be 1100 feet long, 130 feet wide and 45 feet deep over the all. He recommends the same dimensions for the largest cargo ship, and that the same dimensions be lower than the all to permit of facile tating repairs, on disabled ships. Mr. F. W. Fentworth, Statute of the Port of Southampton stated that those vessels which are built for the purpose of carrying passengers, and are not intended for the purpose of carrying cargo, are not required by the largest lines were most anxious to know whether owners and builders would eventually set afloat ships of 600 or 800 tons. He stated that the limit of the size of the largest ships should be set, not by the ship builders or owners but by the dock owners, who would demand that the largest ships should be built to accommodate the largest ships. He tells us that to accommodate a ship drawing 40 feet, which is the maximum draft of the "Leviathan" and "Majestic," costs £800,000. A ship drawing 50 feet would cost double that amount per berth. One authority at the conference stated that the cost of building a ship drawing 40 feet would be £800,000. The cost of building the vessel that lay alongside that berth.

Now, although it seems likely that the increase in first-class travel, and the increased capacity of such travel to pay very high prices, will favor the construction of ships of 1000 feet or over, we are firmly of the conviction that, unless some cheaper method of dock construction can be developed, the 925-foot length, 100-foot breadth, and 40-foot draft of the "Maestic" will be the limit of dimensions for future large passenger liners.

To Bridge the Golden Gate

MORE than one of the leading engineers of that country has been approached at late with the request to give a tentative estimate of the cost of building a bridge across the Golden Gate at the entrance to San Francisco harbor. In reply, they have not hesitated to state that, in spite of the great span of 4000 feet, the design and construction of such a bridge is feasible. The difficulties of the project have been those of politics and finance rather than that of engineering, but recently the California Legislature has authorized the counties to issue bonds for bridge and highway work which they may jointly wish to put through. This removes the difficulty due to the fact that the bridge would join two different

counties, and now that this hindrance has been removed, a Committee has been formed for the construction of the bridge, and the city engineer has announced that a 4000-foot span will be built across the Golden Gate for \$25,000,000.

As with the Hudson River Bridge, the outstanding problems are rather those of finance than of engineering. It would be quite possible to bridge this gap between the headlands at the Golden Gate with a suspension type of bridge. The main difficulty would be not merely by the traffic demand, but by the inevitable growth of traffic in the future. The limit of span for a cantilever bridge is about 2000 feet, and hence the structure would have to be of the suspension type. Now for a suspension bridge, not only is the span limited, but the weight of the bridge itself is a factor. The bridge engineers who have specialized in long span suspension bridges will agree with the statement of Mr. Lindenthal that, considered merely as an engineering proposition, it would be possible, if there were a full span, that it could be made to carry a load of 100,000 tons. It would be specifically stable and sturdy.

The estimated cost of \$25,000,000 seems low for a bridge of this magnitude, and if the city engineer has been correctly quoted, it would lose as though the city were building too much for the present need, and with too little regard for the growth of traffic, rail and vehicular, which the opening of this great roadway and structure is certain to promote. It is a difficult and costly undertaking to increase the capacity of a suspension bridge once it has been completed. Ambiguities will arise as to the exact distribution of the stresses between the old and the new work, and the probabilities are strong that enlargement and reconstruction will involve a sacrifice of the artistic appearance of the structure.

Anti-Railroad Propaganda

CONSPIRACIES among the great institutions and industries of the country which stand out head and shoulder above all others in the United States. The railroad system. Without a doubt, the transportation system of the country is the most important. Life. Let us never forget that. Hence, any plot against the railroads is a plot against the country, for if the railroads are vicious propaganda, which is now being carried out against the railroads, should succeed, the whole system of transportation would be disintegrated. If this should happen, the disaster would embrace not only those who have invested their capital and savings in the railroads, but the great army of railroad employees. The country employs about 1,600,000 people. Included in this number are about 1,000,000 employees, more than 20,000 officials, and if we take the commonly accepted average of five to the family, we arrive at a total of nine million people whose well-being is directly affected by the railroad system. If the railroads are destroyed, the country would be reduced to a state of chaos and increasing number of these employees are holders of railroad bonds and stocks, and if we add to these millions of people outside of the railroads who have invested in railroad securities, we shall find, probably that the people of the country are more dependent on the people are closely bound up with those of the railroads.

The propagandists of the country, headed by La Follette, are trying to spread abroad the fiction that the railroads have placed upon their properties a fictitious valuation which is about ten billion dollars greater than the exact value. The railroads are seeking to have merely a fair valuation placed upon their properties, and they ask that the Interstate Commerce Commission treat them in accordance with the terms of the Constitution as interpreted by the courts. In taking this attitude the railroads would not be asserting that the public comes first. The question is not one of mere academic interest for if La Follette and his associates have their way they will strike a blow at the railroads even more deadly than that with which they have crippled our American Merchant Marine.

There is no doubt that the railroads are today suffering from the "sins of their fathers", but the abuses of robbing, unlimited free passes, etc., have long passed away. President Roosevelt did an excellent thing, not only for his country but for the railroads themselves, when he advocated the formation of the Interstate Commerce Commission. Since its organization in 1887, its existence, this body did very fine work, later, it began to take on something of a political color. Today, however, we believe that the Commission is sincerely wishing to give the railroads a square deal. In this field of effort, particularly in robbing the land and railroad property, as the railroads are referred to, it should receive the hearty cooperation of the country acting through its accredited representatives. In the present situation it is so serious a matter to call for immediate action.

How Fast Shall We Travel?

CONFIRMING the question, to what will be the speed of travel in the immediate future, we must remember that it is essentially one of economics, for the cost rises more rapidly than the speed equally in ocean travel, and there is no reason to believe the public will pay \$6 or 8 for an hour's travel in the air. The writer is unmoved in an article in our issue of April, 1923, by Dr. Ernst Forster, in which he showed that to raise the speed of the "Leviathan" to 28.83 knots equipped would necessitate an increase of her horsepower to 185,000. Forster, however, had not taken into account to be increased at least 1000 feet her height to 110 feet. He showed further that to secure a 35-knot vessel, the length would have to be 1120 feet, the beam 147 feet and the horsepower 380,000. Hence, it was concluded that if we wish to cross the ocean at a speed of over 25 knots, we must do so in a trans-Atlantic

With regard to travel by rail, the indications are that 60 miles an hour will be the maximum speed for many years to come. The fastest train in the world today, travelling on a regular schedule, was placed in service on July of this year on the Great Western Railway, England. The new train runs between Cheltenham and Paddington, England, and its maximum speed is obtained between Swindon and Paddington, a distance of 7½ miles, which the timetable requires to be covered in 17 minutes, or an average speed of 26.5 miles per hour. Although this is the fastest train, there are several expresses in that country which travel at approximately the same speed over hilly districts.

The railroad systems of the United States have no train scheduled to run so fast, although the speed is approached during the summer season between Camden and Atlantic City. It would be quite possible, without any special arrangement, to schedule the express trains to run trains at 60 miles an hour, but of late years it has been the policy of the management to reduce the speeds of our fastest express trains. It will be remembered that, twenty years ago, the New York Central ran a train from New York to Chicago at 60 miles an hour, and the New York and Chicago at first in 20 hours and subsequently in 18 hours. There was a heavy penalty on these trains if they were late on arrival, and the engineers were under orders to make up any lost time as quickly as possible. It is invariably did, and more very fast fuel burner was done.

The writer traveled in the cab of the New York Central's 20th Century train for most of the distance from New York to Chicago and back, and by careful stop-watch timing, secured some remarkable records, including four successive miles in the Mohawk Valley at 83 miles an hour and considerable stretches of tangent down the Hudson River Division at a sustained speed of 75 miles an hour. On the last named run, the train left New York 28 minutes late and in spite of numerous slowdowns made the run of 131 7/8 miles from Albany to Spuyten Duyvil, New York, in 141 minutes.

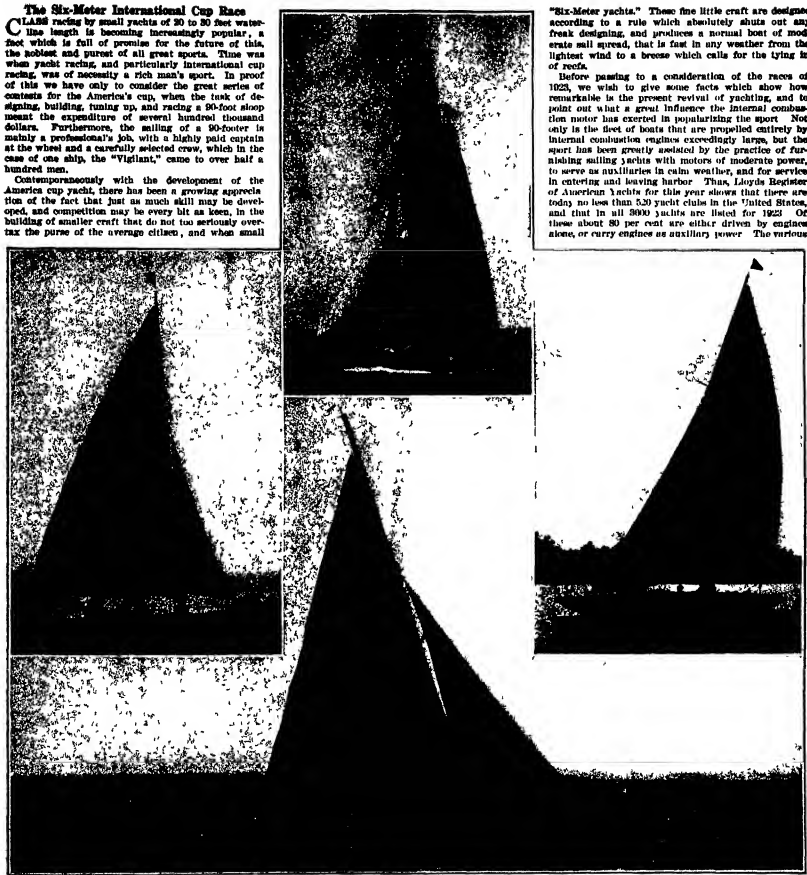
The Six-Meter International Cup Race

CLASS racing by small yachts of 30 to 35 feet water-line length is becoming increasingly popular, a fact which is full of promise for the future of this, the sobriest and purest of all great sports. Thus was when yacht racing, and particularly international cup racing, was of necessity a rich man's sport. In proof of this we have only to consider the great series of contests for the America's cup, when the task of designing, building, tuning up, and racing a 55-foot sloop meant the expenditure of several hundred thousand dollars. Furthermore, the sailing of a 55-meter is mainly a professional's job, with a highly paid captain at the wheel and a carefully selected crew, while in the case of one ship, the "Vigilant," came to over half a hundred men.

Contemporaneously with the development of the America cup yacht, there has been a growing appreciation of the fact that just as much skill may be developed, and competition may be every bit as keen, in the building of smaller craft that do not too seriously overtax the purse of the average citizen, and when small

"Six-Meter yachts." These fine little craft are designed according to a rule which absolutely shuts out any freak designing, and produces a normal boat of moderate sail spread, that is fast in any weather from the lightest wind to a breeze which calls for the tying in of reefs.

Before passing to a consideration of the races of 1923, we wish to give some facts which show how remarkable is the present revival of yachting, and to point out what a great influence the internal combustion motor has exerted in popularizing the sport. Not only in the fleet of boats that are propelled entirely by internal combustion engines exceeding large, but the sport has been greatly assisted by the practice of furnishing sailing yachts with motors of moderate power, to serve as auxiliaries in calm weather, and for service in entering and leaving harbor. Thus, Lloyd Register of American Yachts for this year shows that there are today no less than 520 yacht clubs in the United States, and that in all 3000 yachts are listed for 1923. Of these about 80 per cent are either driven by engines alone, or carry engines as auxiliary power. The various



Top center: "Lee" (American), 29 points. Left: "Coda III" (British), 39 points. Right: "Reg" (British), 32 points. Lower: "Clylie" (American), 27 points

boat racing began to take on an international flavor, with all the competitive instincts to which it appeals, yachting received the greatest impetus which has ever been given to it in all its long history.

Furthermore, it now became possible to dispense very largely, if not altogether, with the services of paid professional skippers and seamen, and there has been bred among us, and indeed throughout the whole yachting world, a race of amateurs who can hold their own both at the wheel or in the handling of the sails, with the best of the professional men.

Another influence which has been most potent in the promotion of yachting was the great war, with the subsequent high rate of wages demanded by the hired hand. This, coupled with the great first cost of a yacht, has rendered it practically imperative that the owner should depend upon himself and his yachting friends for the crew.

Among the many cup, National and International, which are now held each year by year, none has attracted so much attention, or produced such excellent competition as that between what are known as the

Meets of the present year also have shown what a great hold the sport has taken upon the American people. Thus, nearly 750 vessels started in the Regatta during the recent Larchmont race week, and, judging from the number of new boats that are planned for next year, it is evident that the season of 1924 will make an even more remarkable showing.

The first international contest for the cup offered for six-meter boats took place in British waters in 1921. The majority of the races were sailed under the condi-

(Continued on page 292)



Compound microscope with micrometer measuring to 0.00001 inch, used for measuring identification marks, blood corpuscles, etc.

FREQUENTLY a homicide case revs primarily upon the question "Was the mortal bullet fired from the defendant's gun?" For many years, in a large number of cases, conviction after conviction has occurred because the technique used to answer this question, accepted by prosecuting attorneys, the court and the jury as sufficient and convincing, have been faulty. The defendant's attorney has been prejudiced by lack of funds or lack of knowledge from inadequately examining the possibilities of error.

There is a certain rigid scientific procedure which should be applied in all cases involving the question whether the mortal bullet passed through the defendant's gun. All identifying marks must be observed and accurate measurement made that show the caliber of the gun and the bullet, the manufacture and the style of weapon through which the bullet was fired bearing especially in mind that these identifying marks cannot identify individual guns that fired fatal bullets. Serious errors have been made in years gone by, through belief that identification marks that simply indicate the caliber and the manufacture point actually to the particular gun of the defendant.

One of the gravest mistakes in the past has been the assumption that a rest spot or corrosion, either in a groove or on a land in the barrel and resists from the muzzle would mark a bullet so that it would be recognized as a mark of identification on this particular weapon. The marking of the bullet by pitting or corrosion within the barrel is of practically no value in determining the gun that fired it. Hundreds of experiments have been made by firing bullets through new guns from the factory and the bullets have been found to be scored as much as in the case of guns with rusty or pitted barrels. When five guns are selected, four of which are new and one old rusted, and the firing test is made, it is impossible to distinguish between bullets.

Properly, the first question is whether the bullet is used in revolvers, pistols or rifle. It is then possible to determine the make of the gun, pistol or revolver as the case may be. The first marks of identification are useful simply as a preliminary in the next problem. The exact width of a land and a groove have been deter-

mined by proper and exact methods, but the next step is to measure all of them consecutively at the muzzle and from the right to the left around the barrel. It will be found that the grooves and the lands vary measurably in width due to unavoidable inaccuracies in the manufacturing process.

The first thing, therefore, is to determine whether the mortal bullet was fired from the defendant's gun and if the marks were made by the rifling at the muzzle of his gun. The measurements around the muzzle of the gun showing the width of the lands and the grooves will correspond to the marks on the bullet. If it was fired from that gun. The final marking of the bullet comes from the muzzle of the gun and any marks or measurements in the center of the barrel or at the breech are of no consequence in the test. Near the base of the bullet, which is fast to leave the muzzle, will be found the markings corresponding to the gun from which it was fired, and these have to be measured accurately also. Measurements of the gun and the bullet are made microscopically beginning from a certain point and following around the barrel at the end. A set of measurements of the bullet held out to a large scale can be revolved on a similar set of measurements of the muzzle of the gun and if there is a variation of even one measurement, there is a possibility that the bullet came from another gun, and if there is a variation of two or three measurements, it is almost conclusive evidence that the defendant's gun did not fire the mortal bullet.

It often occurs that at the rim of the bore there is some accidental mark such as rust or a burr which causes an elevation of the muzzle. These muzzle conditions leave certain marks or scratches on the bullet, and if the mortal bullet corresponds to these marks and to the measurements of the test bullets, only then was it undoubtedly fired through the muzzle gun. There are few things to be observed and a revolver otherwise an innocent person might be unjustly convicted, due to lack of application of scientific facts.

Just how a criminologist goes about his work of accurately checking up the conditions surrounding a homicide case is well illustrated by the work of Albert H. Hamilton, the foremost microchemist examiner and criminologist in the country, who has figured as an expert in about one hundred and sixty murder cases in all parts of the country, as well as hundreds of civil cases. For example, a few years ago Blaura, N. Y., had an epidemic of burglaries and the city seemed to be infested with porch climbers and keyhole artists, although there was an excellent police department. The police were in a bit of a predicament because they had two suspects in the name of the latter, and were killed in the resulting gun fight. One officer had been shot and killed, the other twice. A search of the neighborhood was made and a man found hiding in a cellar stairway. His leg was fractured, and his .26-caliber revolver was taken from him. The bullet was examined and identified as one of the occupants of the murder room, he was subjected by the detective bureau to the third degree, which resulted in his confession that he had been transpired from the time the officers entered until his capture. The prisoner told who carried the gun and did the shooting, which officers shot first, the order of the shots and why the officers were unable to draw their own guns. This confession was of no value with-

out corroboration, and the detective waited for Hamilton's report of his findings.

In preparation for a scientific deductive examination of the room, Hamilton supplied himself with a special microscope, measuring devices, chemicals, drafting instruments, chemical pencils, resins and rubber gloves. From immediately inside of the door, he made his first general survey of every inch of spot where the bullet would have been fired, and all were carefully calculated where each wound in the human body must be located to splatter the blood where it found. He then reversed this preliminary process and traced the steps from where the bodies were first wounded to where the large spots showed that they finally resided.

It was determined that the first shot was fired when the officers were just inside of the door, but so far there was nothing to show the order in which the shots had been fired, or which had been fired first. The three bullets removed from the bodies of the slain officers at the autopsy were examined by Hamilton and found to be of three different makes. Examination of the rear of the cylinder of the mortal gun showed that the first and second cartridges exploded and contained the bullets found in the chief of detectives, and the third and last bullet entered the body of the chief of police. The first bullet wound had not hit the chief of detective. The chief of police had on a derby hat, and his head was held down either by himself or the burglar who was not shooting. The fatal shot went through the top of his head into the brain and the officer fell, as shown by the large blood hemorrhage. In the pocket of the captured murderer was found a number of .38-caliber cartridges of two different makes which corresponded in size and appearance to those found in the revolver. When Hamilton was asked to make his report was submitted to the detective department and showed a startling corroboration of the story of the prisoner, which he had been sure to tell. It had checked up evenly in the room so accurately that the prisoner was sentenced to life imprisonment.

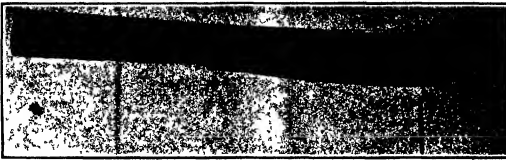
Cases frequently occur where suspicion points to a person as guilty of murder where, in reality, the slain person was killed by a self-inflicted wound. Certain definite steps are taken to prove such conditions, and may be well illustrated by a suicide case. A short time ago.

In a small village in eastern New York, where the principal industry is the manufacture of cotton and woolen goods, there lived a young man and his wife, to whom we will give the name of Brown. Living with the young couple was an aged uncle of Mrs. Brown, feeble and in poor health, he and his wife, although some money, which was deposited in a local bank. Mr. and Mrs. Brown had a son, who was a student at a college. The uncle contributed a small sum at stated intervals toward his support and was cared for tenderly by the young people.

One morning the young man, who had been having been found shot by Brown, and Brown was reported by the neighbors as having seen suspiciously immediately before the door of the house. The bullet had entered, leaving a black mark, the revolver was found several feet from the victim's right hand. Brown explained the "mysterious" death of his uncle by stating that he had heard a shot within the house which frightened him and he came out, but thought of the uncle and returned to his room.

The body was turned over to an undertaker by the coroner with instructions to be preserved without washing or an application to any part of the body. Investigation of the financial condition of the young couple and the old man showed a plausible motive for murder.

On the contrary, the District Attorney and the county detective had been long in the matter and all were agreed on the handling of the case. The death of the uncle was alleged "concomitant of" "moot" danger and pos-



A murdered man had defaced himself with this bullet. The suspect had sworn on his oath, indicating that a knife had started a phantasm he entered the bath and coming out again. The length of the mark and the position between corresponded with the shape of the shoulder of the murderer bullet. The man, and further confirmed by the black marks above them, supported upon the index.

Checking up a weapon against the scars that it produced

able miscarriage of justice, for innocent people often behave in the same manner as guilty ones. They knew that it was possible for a person trained and skilled in the analysis of gun-shot wounds and weapons to examine the body, the weapon, the bullet and the conditions surrounding the death of the victim and determine whether murder had been done or death was caused by the victim's own hand.

Therefore, the body was subjected to a critical examination by Hamilton, which was short, for he knew at once where to look and what to expect, no matter whether the victim committed suicide or was murdered. He first examined the trunk at the entrance and discovered small grains of black gun powder in the edge of the door. Then he examined the floor and found the smoke deposit was less than one inch in diameter. Was it suicide or murder? It is known that in a case of suicide it is possible for a weapon to be found several feet from the hand of a victim who has fallen on the floor. The forefinger or trigger finger of the right hand, however, is usually found near the weapon and the naked eye, and the mirror, registered.

the muzzle. The deposit upon the right side of the forefinger extending about three-fourths of an inch backward and forward from the middle knuckle, made there at the instant the trigger was pulled. The thin opening between the rear of the revolver cylinder permitted the smoke from the discharged cartridge to escape under deposit on the finger. A section of skin was removed from the finger and filed with the coroner, and this was certain evidence of suicide, it outweighed all statements of the neighbors as to the so-called consciousness of guilt which to their minds were sufficient without any further evidence to establish the truth of the charge of murder between the subjects as they think, which no jury could believe.

employment between primitive hunters when were the hunter method of the gull of the hunted man. His situation is directed to the sun-baked elevated plains of Arizona, near the Mexican border, where there dwelt, in an adobe hut an old man of considerable wealth who had the very bad habit of keeping his money in the cane about the premises. Ultimately he was found crushed and murdered, his head crushed in by a blow, and the burglar his throat cut with his own knife.

An Indian was enlisted to trail the murderer, and followed him for many a mile over a complicated course. The first point of interest was a small, dark, rocky hill, upon which a fire had been built, as marked by sunbaked ashes. Inside a piece of a man's undrier was found hurled, with two blood spots on it, at opposite sides, apparently over the wearer's hips. Looking over the ash-covered hill, the Indian saw a few faint footprints, even fragments of the shirt. The trail then led past a blood marked boulder, and finally into a half level village and to the hut of a blackman of good reputation. The Indian then entered the hut, and the house had taken in that morning and given food. He declared in his broken English that she did not know the man nor did she have any idea where he came from. He was arrested as the murder suspect and taken to the police station. The Indian was then made to study the footprints. The tracks

made by the man were declared to be identical with those that had been followed for so many miles.

A casual inspection disclosed no injuries on the man's body, and his clothing was clean and without evidence of blood stains except on the thick edge of the sole of the right shoe, where there was a dark red deposit about the size of a quarter. The man was asked to remove the shirt to be a blood stain, and when the Mexican man was asked to explain its presence he replied that he had been riding a burro and he must have picked the shirt up from the riding arena, accounting for the blood on the animal. There was some plausibility to the story, but it was not possible to eliminate the crude materials of the Indian scene, and lining modern shoes to become soiled with blood was not a possibility either. The man in the blood stain was cut carefully from the sole of the blood stain was cut carefully from the sole of the shoe and was taken from Arizona to Auburn N. Y. where it was subjected to an examination in Hamilton where made a chemical and microscopic analysis and re made the stain on the shoe had been made by a person there.

At this point it will be necessary, to illustrate from the thread of the story long enough to say that there is a simple chemical test for determining if a stain upon any material be blood, but to determine whether or not the blood is from a human being or from an animal is a more difficult problem. Blood is composed of thin, colorless liquid plasma filled with red disks or cells, and with a certain amount of white cells, and a few unmyelinated red ones. The blood is no more red than the water of a stream would be if it were filled with little red disks. Suppose the blood to be very small, as small as a grain of sand, and crowded close together throughout the whole depth of the stream. Under such circumstances the water would look quite red and this is the way in which blood stains are

The red disks or rolls are so small that 1'00 placed side in stile, would measure only an inch and it would take six thousand fold times wise upon one another to make a column of that height. Under the microscope the cells or corpuscles are found to be round at the edges and concave on both sides. It was a tendency to collect in piles like rolls of coins. They are continually fermenting in the blood until as constantly dying. The size and shape vary in different animals and the color of animals varies from pale to brownish red. In the case of the purple scorpion examination it is not difficult to distinguish human blood from that of animals.

Note the five-point-star effect, showing that the revolver had five lands and five grooves, and leading to expert identification of the make.

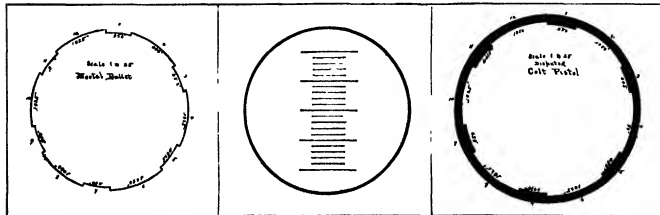
Smoke deposit from a 32-caliber revolver, black

The portion of the undershirt which was buried was next examined, and it was found that the blood had coagulated on the inner surface showing that it had not come from the outside and seeped through. It was therefore evident that the blood came from the person who wore the shirt. It was also evident from the location of the stains that the blood had either come from the thigh or from therotch where it might have stained the back and the front of the shirt.

Next the body of the defendant was stripped to the knees and examined thoroughly. Upon the upper arm, inner margin of the thigh near the knee, flammation and discolor of two fresh appearing, pink colored scars about an eighth of an inch wide, and parallel to each other. The upper scar was one inch in length and the lower scar was one and one-half inches in length. The scars paralleled with the grain of the skin stood erect. They indicated the appearance of completely healed knife wounds caused by a knife thrust where the knife had entered the lower wound and come out of the upper wound. It was evident that the two wounds had been made by a single knife thrust. The large breast knife found near the body was examined and was found next, and it was found that the entire blade had been more or less encircled with blood from a human being.

It was found that the tips of the knife blades were such that points on it could be found at one of white the blade was an 'inch and at the other an inch and three-eighths of an inch, and the distance between which was he same as that between the scars. That settled the matter. In all probability the second knife had been held in the man's right hand of the murder, and the first in his left hand and he had struck upward at the body of the man, and the knife had entered the left leg. It was such a position the knife thrust would have passed through the overalls and under the shirt of the man, and down, and the effect upon his clothes and his skin would have been exactly what it was.

At the murderer's trial the findings of the jury were given to the jury. The defendant on the stand admitted that the scars were made by being gored by a vicious goat when he was a boy, but every juror, all ranchmen, knew that the narrow scars were made by some instrument similar to a bread knife. The conviction was secured on the showing of the bread knife and the scars. It was never known how much gold the murderer had buried. The thousand dollars in gold coins were found buried in cans beneath an arbor at the victim's home. The murderer was sentenced to life imprisonment.

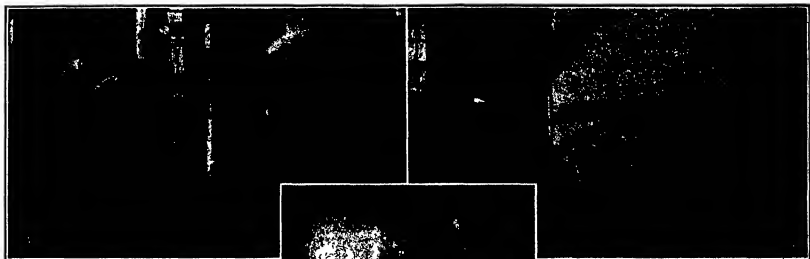


Left: Cross-section of a murder bullet, magnified 88 diameters, with actual dimensions marked of the grooves and lands. It was claimed that the bullet was fired through the Oak pistol, whose muzzle dimensions are shown at the right. Center: Microscopic micrometer scale used in making delicate measurements. Right: Cross-section of the disputed pistol, showing, by divergence from the marks on the bullet, that the latter could not have been fired from this weapon.

Behind the Underwriters' Label

The Gruelling Tests Imposed by the Insurance Man Upon Materials and Appliances

By A. G. Ingalls



THEN we read that a manufactured product has been "approved" by the Underwriters, what is the reaction that takes place in our mind? Obviously, the phrase has a favorable significance. But what if the Underwriters would not include it in the description of the product? If we are the average human being, busy with troubles of our own, the chances are that somewhere in a remote corner of our mind we may have a bad idea that the sample of the product is not as good as the frequent praise of the manufacturer, when he got around to it, sent a representative of his product to the Underwriters, and the latter, turning it over in their hands and smelling and sipping it up said it looked as if it wouldn't burn very easily and so wrote back that we had as well forget it. We could use their labels and money! If they wanted to

But it isn't done that way. The way it is done, which is the gist of this story, is the best sort of proof that it has earned the right to bear the words, "Underwriters Laboratories—Inspected," a product must have passed through an unbroken, figuratively and literally of fire and water. When the Underwriters have finished testing an appliance, or a new kind of roofing, or of flooring, or anything else and have approved it—if they have approved it—it is a safe bet that it not only involves a low fire risk, but is from every ordinary angle a good and dependable piece of merchandise.

How they do go out the job he only and interventional told in a work entitled "A Rhythm of Noddy," to Harry Chase Brearley, who begins at the beginning and tells us how the idea came about. The idea was to have a growth out of an idea in the mind of one man that grew up over time. It was in 1980, the year of the World's Fair at Chicago, and the electrical installation at the fair was for those days, unprecedented in size. On one side of the fair, there were thousands of electrical equipment and the fire insurance companies were worried about the possibility of a great fire starting at the exposition. So they decided to have a fireproof building built for the young man named W. H. Merrill under the suggestion that an electrical testing laboratory be set up. So well as his idea that he was given a small room and did not feel like the modest luxury of a helper and

When the Chicago exposition job was done, Mr Merrill was told to go right on doing the same work for the Underwriters. He is doing it yet. Today he is president of the Underwriters' Laboratories, Inc., of Chicago, but instead of the two helpers of thirty years ago the work keeps 170 busy. And it is still growing.

When it comes to titling just what sort of thing is the Underwriters' Laboratory pass judgment on, it is hard to include them under any single heading—insurance, simply, "things." And this would not be half as inaccurate as would be an effort to name them all within the space of this page. The Underwriters' interest pertains to everything that enters into the construction of any building that is to carry fire insurance, and then extends to devices designed

1. Turning a fire hose upon a metal window-sitting just out of the furnace, to test its fire-resistant qualities. 2. Examining automobile headlight for its anti-glare properties. 3. Trying out a motor-driven oil burner to determine whether it is sufficiently fool-proof to remove the probability of its being tampered with by the user.

Three widely different tests whose successful passage means lower insurance rates to the user of the equipment in question

to reduce insurance premiums of any sort whatsoever. The Underwriters want to know, and they make ex-
haustive tests in order to find out just how much
damage there is in the various services. The first
fire test is on the pipe, and its parent rod, from light
cigarettes in the office wastebasket. As a small in-
stance, what is the fire risk in a particular make of
electric curling iron? They don't know, so they test
it. They find out that the iron is safe, but they find
that could ever happen to red hot hair surrounded by
a possibly defective shelf. Experience has taught them
that no matter how foolproof an appliance is, no matter
what instructions for its proper use come with it, someone
will use it wrong. The Underwriters' Laboratory
start a fire (lived dolls) use by thousands of people
no chance of starting a fire in some peculiar case
now is to remove. So in the Underwriters' Labora-
tory the electric curling iron is tried and tested and
"passed" and "approved" and "insured" and "insured"
always having to run on thing-how might it



Burglary insurance underwriters testing out an alarm, to find whether a crackman could disconnect the gong without breaking the wire and turning in an alarm.

Necessarily, since all kinds of things are to be tested in the big Chicago laboratories include several kinds of work. There is a chemical laboratory, an electrical laboratory, a mechanical and a hydraulic laboratory, a fire-testing laboratory, and several others. In all these laboratories there is an immense amount of testing apparatus, and it has to be added to continually because there is no uniformity in the nature of the things to be tested. When a brand-new device reaches them someone has to think up a new apparatus to test it with.

[illegible]

There is no compulsion on any manufacturer to have his product inspected, but the service has come to have such a reputation for honesty and reliability that its approval is a highly valuable asset to him. This the Underwriters do not begrudge or envy, but it is really an accidental by-product of their work. For the maintenance of their work proceeds from self-interest.

Returning from the field to the Chicago laboratories and choosing for illustration something which is obviously important from the point of view of inflammation, the author has chosen to illustrate the following: First, it is approached within ten inches from a plate of iron heated to 2100 degrees Fahrenheit and held there until flames break out. The time required gives a test of the heat-resisting quality of the roofing with regard to the breaking of itself alone. Second, a 1/2-inch brand is let burn freely while lying on the roofing. This gives a test of the fire-resisting qualities with regard to brands burning from adjacent buildings. Third, a roofing sample is placed in a test chamber in which forms the subject of our current paper design. A roaring mass of oil-fume driven by a 15-horsepower vertical wind strikes the surface of the roofing until it is ignited. This is a test for ignition and the rate of spread of flame. The results of these tests are given in the following table:

Automobile Race Track on Factory Roof

TO EXPEDITE the testing of its automobile under actual race conditions and at varying speeds, a well-known Italian automobile company has constructed on its factory roof what is no doubt the first race track of its kind. As the automobile chassis leave the assembly shop, they are placed on an elevator and carried to the roof of the factory in which they have been built, where, more than 100 feet above the level of the ground, there is a track 75 feet wide and nearly three-quarters mile around, on which the chassis can be run under the direct control of the staff engineers. The track, formed of two straight stretches united by banked curves 20 feet high, permits of operating the cars at the highest possible speeds.

The odd automobile testing track occupies the greater part of the roof of an immense rectangular factory building at Magenta, a suburb of Turin. The works consist of two main parallel blocks, united at their ends and measuring 1270 yards around. The space between the two main blocks of buildings is divided into four large courts by three transverse buildings, which afford ready communication between the five floors of the factory, by means of four electric elevators in each transverse building. In all, there are seventeen electric elevators in this huge plant.

The roof track is constructed of reinforced concrete with a special kind of surface troweling. A thick concrete wall five feet high, on each side of the two straightaway sections and on the heads of the curves, is built up nearly ten feet high on the outside of the curves, ensuring safety for the drivers. Advantage is taken of the transverse buildings to install workshops in the available space below the track. These workshops are used by the test drivers to make the necessary adjustments on the chassis after the trial runs.

The straightaway sections of the track are slightly cambered in order to allow water to run off into the gutters on the sides. At the hot water heating pipes are carried on the ceiling of the shops immediately under the track, there is sufficient heat to melt snow as it falls, so that the race track is available throughout the year.

Chassis to be tested are brought up by electric elevators in the transverse buildings. After receiving their quota of gasoline and oil, as well as water for the radiator, the engine are started and each chassis sets out on the track. On returning, each driver reports in writing to his chief, who examines the chassis and the test driver for further tests, each driver reporting in turn. If no defects appear, the chassis is returned to the factory. Chassis which are defective are sent down to the body department or for delivery, as the case may be. After the bodies have been fitted, further tests have to be carried out on the track in order to ascertain once more that all the mechanical parts function correctly, and that the electric lighting and starting system operate satisfactorily.

From morning until night the roof track represents a scene of bustling but well-ordered activity. At regular and frequent intervals the elevator doors are raised, a chassis is pushed out a few minutes later it joins the group of all kinds of vehicles from bare chassis to finished, immaculate touring cars and around the speedway. Heavy trucks keep low down on the banked curves, while sport chassis spin around near the top.

Express Company Equipment TRANSPORTATION with an express company must be reduced to a science. To unimpaired selection of equipment or guess-work method of operation or slipshod method of maintenance can be tolerated. Edward R. La Bonte of the American Railway Express Company discusses interesting facts regarding equipment used by our largest express company.



General view of the factory-roof race track and one of the four courts in the center of the plant. Workshops for making adjustments, placed under highly banked curves, are reached by inner track.

During the past year more than 184,000,000 shipments were handled and these shipments had to be handled at least once at point of origin and at least once at point of destination, in addition to landings on route. The average weight per shipment was approximately 22 pounds, producing a gross revenue of approximately \$2,000,000,000. From the magnitude of the business it can readily be seen that it is necessary to make a most careful selection of vehicle equipment.

In New York City the company requires 600 motor vehicles and approximately 100 horse-drawn. In Chicago they use in daily service about 130 horse-drawn



Another view of factory-roof race track, showing a banked curve 20 feet high. High speeds can be developed in safety on this track.

vehicles and 300 power vehicles, including 25 tractors with about 10 trailers. The total vehicle equipment throughout the United States and Canada consists of 3300 gasoline vehicles, 1100 electric street trucks, 324 electric industrial platform trucks and 100 semi-trailers, about 8200 horse-drawn vehicles, which means a total of 12,750 units of which approximately 25% per cent in numbers are motor vehicles with 50 per cent of the total capacity. Statistics show that in express service the horse-drawn vehicle is now approximately



Right-wheel motor truck with one of its right rear wheels on a 10½-inch block. The traction was raised only 4½ inches, due to the unique spring construction.

12 miles per day, the electric vehicle 20 miles per day and the gasoline vehicle 20 miles per day, which surely is sufficient advantage to justify their preponderance.

The Acid Test for the Eight-Wheel Truck

COMB interesting and unusual tests were recently made with the eight-wheel motor truck recently perfected by Mr. H. H. Sargent of San Francisco. One of the right rear wheels was run upon a block 10½ inches high. Measurements were then made with it showed that the traction was only raised 4½ inches. In another test one of the rear wheels was run upon a block 12½ inches high. During this test the traction was only raised 4½ inches or only three-tenths more than with the 10½ inch block.

All of which is due to the unique spring construction. The reason two sets of springs on each side with four connected. The traction is free to rotate in a bearing which is carried between the upper and lower springs on each side, and it was because of the flexibility of the axle construction that the traction was raised only 4½ inches when one of the four rear wheels was on the top of the 12½ inch block.

In another test the truck was run on railroad tracks without coming up, jar or jolting of the passengers.

The truck was driven from San Jose to San Francisco, a distance of 81½ miles, in two hours and fifteen minutes. Two men rode in the cab and the driver started the line the same as in a touring car.

This truck can carry nine tons and tow a total of 25 tons, at an average speed of 50 miles an hour. It makes six miles a gallon of gasoline with varying loads.

Experts who have seen this eight-wheel truck in operation state that it has many advantages over the four-wheel truck for rigid transmission of large loads of perishable goods, such as fresh milk and ripe fruit. The extremely wide axle spacing of both front and rear sets of wheels eliminates three-quarters of the road shock. The milk is not churned nor the fruit bruised.

The small wheels with low spring suspension bring the weight close to the ground and allow ample road clearance. The location of the truck keeps the wheels down in contact with the road, thus preventing any steering and constant motion. Skidding, or overturning is impossible in any ordinary operation of this truck. Small wheels and small tires insure the steering of this car in spite of blow-outs or even the loss of a wheel. It makes a lane on all right-hand curves and is a great asset in the steering of this car in spite of blow-outs or even the loss of a wheel. It makes a lane on all right-hand curves and is a great asset in the steering of this car in spite of blow-outs or even the loss of a wheel. It makes a lane on all right-hand curves and is a great asset in the steering of this car in spite of blow-outs or even the loss of a wheel.

The front and rear wheels are all alike, and the small rear wheels are of large size and are evenly distributed and the load balanced so that the front wheels carry their proportionate load, instead of the load being concentrated on the rear axle. It follows therefore that machine is smoother and quieter. Elimination of slippage and skidding save wear on driving tires. Instead of one place permit the front wheels to run straight, thus avoiding wear of tires due to constant "toeing in." Drive linkages are double-acting and of large brake area and even application. Fuel is not wasted in bouncing and racing of the driving wheels over irregular line of the road.

Freedom from twist and jar secure long life of frame and body of the truck. Minimal weight per wheel gains approval of highway superintendents. Passengers are saved from concentrated impact and time from overloading, by eight points of contact with the road. Free steering gives braking and comfortable ride even in the most unimpaired to watch the vicinities, according to the plans made to the designer of this novel truck.



Rebuilding a worn axle

A 44-inch slab shear, welded for \$533. New plate would cost \$4500

Repairing locomotive frame in place

Electric Welder Vs. Riveter

The Past Successes and Future Promises of Electric Welding

AMONG the many valuable services rendered by electricity may be reckoned the art of electric welding, which already holds an established position and promises, as it looks down old, established practices to supersede, certain constructive and repair work for which it is peculiarly well fitted. Although the recognition of the value of electric welding is of comparatively recent date, it was successfully done by John Thompson nearly half a century ago, and down through the years it was used in a more or less tentative way until the Baldwin Locomotive Works and the Erie Railroad began to make systematic use of it on a large scale. The Baldwin Company did not hesitate to apply it in both construction and the various locomotive builders and the rail road shops of individual railroads in the United States have employed it both in boiler construction and repair work, and in the repairs of broken-down cylinders. The Erie Railroad in particular, for many years has secured excellent results in using the electric welder. In the repair of its locomotive cylinders, for instance, the use of electric welding is now so general that a large number of repairs can be made without withdrawing the locomotive from service.

The very gratifying success which are welding has achieved in locomotive building and repair work now leads to its application in marine work. Her efforts have now almost demonstrably shown that the United States Navy cannot afford to neglect the use of electric welding in its war ships. They were long in use in ports and destined to turn them into transports for carrying the United States troops to the flower of war in Europe. Although this is an old story, it is so pertinent that the outstanding facts may well be recapitulated.

When our entry into the war became evident to the German Government, they sent instructions to the officers of the German ships in our ports to be thoroughly alerted the engines that it would be impossible for us to make use of them for a period of four or five years. In carrying out these orders, the German engineers were careful to destroy the engines in their most vital parts and to injure them in such a way that it would be necessary to make exact drawings, prepare patterns from these drawings and make new castings. This would have necessitated the gathering of a large force of draftsmen and the placing of a burden of many very heavy work upon the builders of marine engines, although at the time destruction was severe, and our shipbuilding yards and engineering shops were already very crowded with such orders. The Germans of course were familiar with electric welding, but they had not themselves ever done any satisfactory welding of cast iron, they definitely believed that we knew no more, if we made of this matter as they themselves. It was stated indeed by the Secretary of the Navy that "a survey" by representatives of the United States Shipping Board, it was decided to

make new cylinders, valve chests, etc. as built were these parts broken on the damaged ships.

While the subject was under discussion, a few of the ships were transferred to the Navy and sent to the New York Navy Yard for repairs. Here Captain B. P. Jenson, after conferring with an electric welding company, recommended that the broken cylinders be repaired by welding. In this he was heartily supported by Rear Admiral Ward, the Industrial Manager of the yard and ultimately the Bureau of Steam Engineering issued orders to make the repairs when possible by

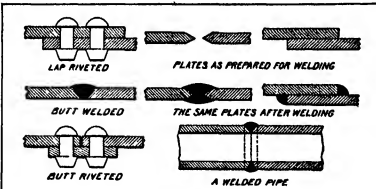
our troops to Europe and bringing them back again.

In a report on the matter, the engineers in charge of this particular work say that on the cylinders of the twenty vessels of German origin, not counting for a moment the turbine-driven "Vaterland," there were no less than 118 major breaks. Had not the welding been available, the repairs would have entailed the removal of some twenty cylinders. It should be noted, that in spite of the large scale of the damage, the work was done in place on the ship, the cylinders not being in any instance removed. After careful estimate by the Navy Department it was estimated that the use of arc welding had resulted in the saving of twelve months' time and of \$200,000 in cost.

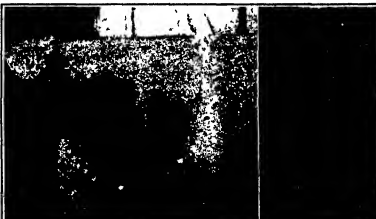
We have referred already to the necessity for heat control where the electric arc is used. The system used on these ships, and most successfully used elsewhere, is that known as the constant potential, low voltage system, which operates in a general voltage of thirty-five. With this voltage it is possible to deliver and maintain a critical degree of heat at the weld, and to insure a proper fusing of the original and the added metal. The metal to be welded forms one terminal of the circuit and the other terminal is a steel wire of a composition suited to the particular work. This electrode is brought into touch with the metal and withdrawn until an arc about one-eighth of an inch is established between the electrode and the metal to be welded. The great heat fuses both the work and the electrode, and the metal from the latter is deposited on the metal. In preparing the shattering edges for welding they are so shaped as to provide a "V" shaped depression, which, beginning at the bottom, is gradually filled up by successive layers of metal are deposited from the electrode. Referring to the work done in repairing the marine cylinders on the German ships, Captain Jenson states that investigation of the structure of the weld shows only a very slight vein of hard cast iron at the line of the weld, almost through with fibers of gray cast iron, well behind this area there is visible no heat effect whatever. The metal thus deposited

electric welding, and to resort to mechanical joining, only where welding was impracticable. Some of the accompanying illustrations show the character of the breaks in the cylinders etc., and give clear evidence of the serious nature of the injuries. So bad were they that a memorandum of the injuries was sent in Germany and found on one of the ships, ended with the slightest call remarks, "cannot be repaired." Nevertheless, all the ships were put in shape and ready for sea duty within five months' time and the sections which were then welded in place have held and gave no trouble whatever after long and arduous service in carrying

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Comparison of riveted and welded joints



Left How the Germans drilled and then knocked out sections of cylinder
Right Similar damage in a cylinder liner. Both welded and giving good service

(Continued on page 237)

A Reader That Turns Itself

By Dr. Ernst Fournier

ACCOMMODATING navigation was caused in Europe when shipping circles when the new Flettner rudder was first adopted in the "Odessa," a cargo steamer of the Latvian Line. The idea of this rudder is to do away with power steering by steering engines entirely, using the wind to turn a small auxiliary rudder ("deflector") installed in the back part of the rudderplate, to move the main rudder. The combined effects of the main rudder, the small auxiliary rudder, and of the power of the current acting upon the whole system, give a turning movement on the main blade with the effect of a prompt and accurate steering action. The motion of the small rudder is controlled by means of a mechanical gear, composed of a pair of yokes and horizontal rods, transmitted vertically through the low axis to the head of the main rudder post. In the case of the "Frigid" there is a drum connected with the top of this gear upon the rudder head, where a steel rope actuator gear passes to the wheel on the bridge. After this 200-ton vessel performed satisfactory service for 2½ years it was decided to apply it to a larger vessel, the "Odessa," of 5000 tons register. The operation of the rudder will be made clear by a study of the accompanying line drawing, which shows the essential features of the device. A vertical shaft, operated by the steering wheel at *P*, is geared to a horizontal shaft, *K*. This, in turn, to a vertical shaft, *P'*, which by means of level wheels at its lower end serves to operate a series of horizontal shafts, which terminate above the rudder post, *P*, of the main rudder. The rudder post, *P*, is geared to a horizontal shaft, *A*. The horizontal length of shaft *A* above mentioned is to the graced, by means of level wheels, with a vertical length of shaft which passes to the main rudder post, where it carries at its lower end a yoke, *C*, which, by means of a pair of horizontal rods, is attached to another yoke at the head of the small pilot rudder, or deflector, *B*, located at the after end of the main rudder. It will be seen that by operating the steering wheel, *P*, the pilot rudder, *B*, may be caused to turn to port or starboard, at the will of the steerman.

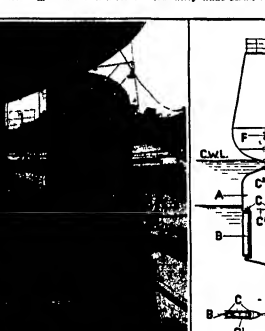
When the pilot rudder is turned to port, let us say, the rush of water toward the rudder, in a pressure to starboard, which, acting on the long lever arm representing the distance from the pilot rudder to the axis of the main rudder, exerts a powerful pull to starboard and throws the main rudder to starboard. Similarly, the streamman turns the pilot rudder to starboard, its action will pull the main rudder over to port. Furthermore, the turning moment will be proportional to the amount of deflection given to the pilot rudder, and the main rudder will assume the desired angle of beam.

The "Odessa" rudder, which was built by the Deutschen Werft with all the necessary gear, has about 140 square feet of surface. The deflector has about 28 square feet. Both are partially balanced, and both are fish-shaped in their horizontal sections and hollow. The turning gear of the deflector is independent of the motion of the main rudder, the latter being able to move freely in a complete circle like a weathercock. This always happens, when the ship is to go astern. Then the risk of water toward the propellers automatically turns the rudder through 180 deg. and it then acts as a bow rudder. The steering principle thus remains the same, the pilot and the main rudder acting very promptly under the influence of the propeller suction. The main rudder reverses itself under the influence of the water, the turning propellers before the ship herself has begun to go astern. The deflector gear leading from the rudder head to the wheel on the navigating bridge, in the case of "Odessa," is a rigid one, with one-inch round steel rods carried in bearings on deck. The pilot gear is a self-governing wheel. This gear was worked satisfactorily on a 40-hour trial, when the vessel was steered by the

hands of a wheelman, and the ship was placed in regular service without any material alterations, the only change being the substitution of ball bearings to reduce friction.

The Hamburg American Line, as owners of the "Odessa," has a considerable investment in, and named this ship, with another one of no less importance, called the "Anshlitz-Kreisloppschiffahrtsgesellschaft." In the construction of the grooved compass has been developed by the same inventor to take the place of the wheelman. This result has been obtained in the following outline. At its circumference of the compass are electric contact points, opposite to which a single contact point is fixed in the body of the compass. In the lower part of the compass, an electric motor of about one-half horse-power is provided, which is connected by a shaft chain to the axis of the steering wheel. The motor is controlled by the above-mentioned system of contacts, depending on the turning motion of the ship. The effect of the wheel then is the same with the ship is to follow—the motor is automatically and continuously corrected in the gyroscopic electric deflector just described. The steering is more exact than that by an actual wheelman, and it has the advantage that it never goes tired.

One marked advantage of this automatic steering is that the course is straighter than that achieved by hand steering, with which a more-or-less wavy wake results.



This rudder is operated by the small pilot rudder B, which is pivoted at the after edge of the main rudder. A. Pilot rudder is operated by steering wheel P, through shafting P', P', and yokes and link C C.

Earthquakes

FROM the very earliest times the notion of man has been assailed by earthquake phenomena. This, particularly the case in those countries which have been perturbed by disastrous shocks. The Chinese and Japanese records contain frequent references to the destructive effects of the larger shocks. The importance attributed to such events in its well illustrated by reference to the chronology of the Jews. The great earthquake which occurred in the reign of Uzziah was used as a datum point to which subsequent events were long after referred.

Such events could not come and go without arousing curiosity and speculation as to their origin. In an ill-revised or semi-barbarous communities these speculations either attributed the cause of earthquakes to the invocations of some supernatural monster or to supernatural agencies. Among more enlightened people a more rational attitude of mind prevailed. For example, Aristotle, Ptolemy and others held the view that the movements were due to impulsive wind or vapors seeking to escape from beneath the earth—a view after all not far removed from the more modern theory of a volcanic origin for earthquakes.

As the horizon of human knowledge widened through geographical discovery the intimate relation between the earthquake and the volcanic origin became more apparent, and it was natural that earthquake phenomena should be attributed to volcanic energy. This has been the dominant view of the last century, and prevailed until its last decade. This may be seen from the view expressed by Milne, the father of modern seismology,

as late as 1893. He says, in summarizing a discussion on the causes of earthquakes. Although it would be an easy matter to discuss the relationship of earthquakes and other phenomena, we must conclude that the primary cause of earthquakes is undoubtedly to our earth, and that eruptions and volcanic phenomena, fluctuations of the sun and moon and barometric fluctuations, may but a small part in the actual production of those phenomena, their greatest share consisting in the mere prescience in the number of earthquakes at particular seasons. This may, therefore, sometimes be regarded as final cause. The most striking facts are due to explosive effort at volcanic heat. The greater number of these explosions take place beneath the sea, and are probably the cause of the volcanic eruptions, showers to the heated rocks beneath. A smaller number of earthquakes originate at actual volcanoes. Some earthquakes are produced by the sudden fracture of rocks within or the production of faults.

"This volcanic theory is now generally abandoned as its chief or even as a very important cause of earthquakes though it is, of course, admitted in special cases."

Larikarjan are now almost universally recognized as being of tectonic origin. This change in opinion has been brought about chiefly through the labors of M. de Montessus de Ballois and the late Edward Suess. Both these authorities have demonstrated the intimate relations between those of crustal weakness and the distribution of earthquakes.

M. de Montessus de Ballois, has attacked the problem on a grand scale, taking the world for his province. Suess has particularized and demonstrated the relation of such districts as the Alps, the Himalayas, the Andes, the Cordilleras and other centers.

The most striking and convincing illustration of the truth of the tectonic theory were afforded by the surface phenomena accompanying the great earthquake which shook Japan during the Nineteenth century. The Assam and the California earthquakes are also of tectonic origin.

A great many other workers among whom, perhaps, the most prominent are the late Professor H. H. Wood, have long since recognized the relation of earthquakes to faults, joints and the tectonic origin of earthquakes may now be regarded as being finally established.—Abstract from article by I. I. Cotton in the Bulletin of the International Society, Nos 2 and 3, Vol 12.

Proof of Einstein's

THE light from the interior of the atom, as well as the light from the surface of the electron, gives evidence in support of the theory of relativity advanced to Professor A. Sommerfeld of Munich.

According to the modern view of the internal structure of the atom there is a central nucleus of positive electricity around which revolve at high speed one or more negative electrons. These may move in circular or in elliptical orbits so the planets around the sun. If the orbit is a circle the electron moves in a constant speed throughout its course. But if the orbit is an ellipse the electron must move faster when it is making the turn nearest to the center, and slower when it is making the turn when it is at the more distant end of the ellipse. This difference in speed would make an difference in the mass of the electron as it moves around the nucleus. According to the modern view of the atom, the mass of the electron varies, for the reason that mass was made up of matter. But according to the new Einstein theory, a particle is not made up of matter, but it is a wave moving slowly, so that the electron would vary in mass in different parts of its elliptical orbit and therefore the energy it gave off in the form of light would vary in the shape as well as the major diameter of the orbit.

There are only a limited number of such orbits that an electron can pursue, and in slipping from one of these to another a certain quantity of light is given off which may be compared to the emission of light by the light given off from the incandescent gases, hydrogen and helium, as well as the X-ray spectrum of heavy metals. The explanation also that the corpuscles make up the atom, as Einstein has instead of Newton's. Thus Einstein's theory will not only not

Psychic Adventures on the Continent

Sittings with an Apport Medium in Berlin, and Interviews with Several Notables

By J. Malcolm Bird

Associate Editor, SCIENTIFIC AMERICAN, and Secretary to the SCIENTIFIC AMERICAN Psychic Investigation Committee

ONR were liking out independently, a possible tour of Europe, one would probably devote more time to the Continent than to England. My expedition, however, had primarily to do with spirit mediums, and only secondarily with items of psychic interest in France, Germany, etc. Nevertheless, it was my intent to give as much time as possible to a swing through the Continent, and I finally got away from London on the evening of March 13, immediately after my sitting with those devoted to my time lapse through the knowledge that Paris was my first point of call, my schedule was left to turn itself out.

In Paris I had very interesting conversations with Dr. Geley research office in charge of the Institut Metapsychique International, and with Prof. Hiltel whose recently published book "Thirty Years of Psychic Research" will be reviewed in these columns at an early date. I need say nothing here about these interviews, since I arranged with Dr. Geley for several signed articles, in which he will tell of his work and of the general state of psychic research in France better than I could possibly do on the basis of such short examination as I was able to conduct. I was Dr. Geley's laboratory and his museum and was enormously impressed by the materials obtained allegedly as results of the hands of materialized spirits, in the presence of the Polish medium Kikote. These results have had actually described in America, and were not that I have on my desk at this moment a letter from this gentleman, the illustrated within a very few days of a comprehensive article on them, accompanied by photographs. I should judge longer over them here.

Before and after leaving London I had been in communication with Dr. Alfred Trincaut, the very valued Berlin correspondent of the SCIENTIFIC AMERICAN. I had been anxious for him to go to Munich and meet me there, since at the moment the Bavarian capital seemed like the psychic center of Germany. Hence, in his family made this impossible however, and at his urgent recommendation I went to Berlin first, as his radio message said "on matters of psychic and editorial interest."

Dr. Trincaut had arranged for me first to see the International psychic laboratory, which he had already described in our issue of July, 1922. I found the ap-

paratus extraordinarily interesting, and Herr Trincaut would not let me go until I had been able to see at a sitting at the apartment of Frau Vollhard, and this was held on the evening of March 20.

Frau Vollhard is entirely in the hands of Dr. F. Schwab, a practicing physician who has been examining her mediumship for several years. Dr. Schwab had all settled in his own mind as to the price of the sittings. I was to agree, right unseen to publish in the SCIENTIFIC AMERICAN an article which he had written about his medium. My subsequent refusal to do anything with the article beyond reading it and making a recommendation to the home office threatened to bring

WITH the present article, Mr. Bird concludes his accounts of his informal sittings with European mediums. He has had one more informal sitting in this country which will ultimately be described in our columns, and the prospect seems good that he will have further accounts of this character, in addition to the formal test sittings held before our Committee. In the meantime, there will shortly appear, under the title "My Psychic Adventures," a series in which he will describe, much more fully than he has had space to do in these columns, his impressions of, and experiences with the mediums whom he has met informally.—THE EDITOR.

me to a deadlock, but we finally found a way out. I agreed to pay him a sequence fee of ten dollars, and to render him the same amount monthly in the form of advertising and reproduction in our columns, I was so recommended, and if it was thus used, the ten dollars was to be deducted from our payment for it. When the article reached my hotel the next morning I was awfully surprised, it was in no means as hopeless as I had feared. The sequence fee was a great deal of the accompanying information about the medium. I suppose we must forgive the middle class French for getting excited by the presence of anyone who has access to the fountains of dollars.

Dr. Schwab first became acquainted with Frau Vollhard in the fall of 1920. Prior to her work with him, she sat only in the most restricted circle of her intimate acquaintances. At these sittings telekinetic phenomena occurred, with numerous apparitions. Nothing was seen of ectoplasia or materializations.

Telekinetics, the movement of objects without contact, is familiar to my readers. I have no doubt. Apparitions, however, are not. The idea is simple enough, and plausible enough. If a given force can move a vase of flowers across the room, it seems self-evident that it could be applied in greater conversation and with greater power, it can move a man across London, or a table across a continent. In its simplest terms, the spirit is simply the bringing into the scene some, of a material object that was not there before. The spiritists are very clear indeed that the object is not materialized out of nothing. It is brought from some where else, and disappears from this other place just as it appears in the scene room. The identification of the phenomenon with telekinetics seems immediate until we learn that an apport is just as likely as not to occur in a sealed room. Then there enters the very pretty problem of how the extraneous object got through the walls. The believer finds this simple enough. It was dematerialized, filtered in through the molecular interstices, and was reassembled within the room. If the phenomenon really occurs, some such explanation as this must necessarily be accepted.

To return to Frau Vollhard, Dr. Schwab, soon after his admission to her sittings, set about to create them in the interests of science. He set up better controls and better conditions for observation, brought in apparatus of various sorts, but a permanent record of all the sittings, interested other scientists and got independent witnesses, carried out medical and anatomical tests upon the medium, etc., etc. Frau Vollhard was sufficiently impressed by this pie of scientific expedience to have submitted to all this. But she has a limit beyond which she will not go. In conversation about her table, the abstract proposition was advanced whether she would qualify for our formal investigation. Her interest was acute when I translated her into marks at 20,000 per dollar, the prevailing rate, but she was very certain that, even for the purpose of winning

such a colossal sum, she would not sit in other than her own clothes, and would not submit to more than a perfunctory search.

With Dr. Schwab's introduction of science into the scene room there came a surprising shift in the medium's scope. When he first tried to get photographic evidence of telekinetics, he found ectoplasia in the developed picture, and pursuing this lead, he got very many photographs and visible appearances of this much retroverted substance. One would be fairly certain that the medium was not sufficiently well-versed to know anything about ectoplasia, or sufficiently clever to counterfeit it. Her daughter is always present,

however, and with regard to her father of these assurances would be valid. If there is fraud, she would be certain to be the guilty one.

Not long before the date of my sitting, the medium had without apparent reason abandoned the production of ectoplasia, and returned to her original line. As I was given reasonable assurance that I should have some supports, and made to understand that nothing else was likely to occur.

The medium sat at the end of a small oblong table. On one side Dr. Gradewits and on the other I, met at the side of the table around the corner from Frau Vollhard. Next to me came Dr. Schwab and then the medium's daughter. On Dr. Gradewits' side sat two gentlemen who were present for the first time. One was a Herr Indenstein, and the other was apparently also the holder of some official position. There was complete darkness save when Dr. Schwab flashed a red torch to make an observation of some sort.

There were no preliminaries. We simply sat down and waited, conversing. The medium was greatly relieved to learn that I was not a violent skeptic and even more so when she discovered that I could manage to keep up with the conversation. She had apparently had a mental picture of Dr. Gradewits and myself, exchanging impressions in English, of which nobody else present would understand a word.

We had been sitting for but a moment or two when she began making weird noises, she breathed rapidly, shuddered and groaned, and occasionally cried out loudly. The medical man who is present when a female medium sits in this way has a good deal to say.

(Continued on page 289)



Frau Vollhard caught in the act of producing ectoplasia



Another characteristic view of a scene of ectoplasia

Smashing Dishes to Solve Their Secrets

Why Uncle Sam Breaks 6,000 Samples of Plate and Window Glass and More than 2,000 Pieces of China in Novel Tests

By George

H. Dacy

THE CRACK and clatter of broken crockery and glassware resound now and in one of the National ceramic laboratories at Washington, where Uncle Sam is testing out all kinds of glass and china for durability and service. A huge testing machine that is expected to develop a pressure as great as 100,000 pounds is used as one of the agencies of glass destruction. This monstrous apparatus is employed to try out concentrations of force at different points in the glass specimens. By its use accurate data are obtained relative to the aggregate strength of various kinds of glass for different purposes—information that previously has not been available.

All kinds of building glass, such as window glass, are being surveyed. A curious water pressure system is used to simulate the wind pressure which the western gales exert against the window panes. This experimental setup also permits of securing data of great value to architects who sometimes have to plan and design aquariums and other structures made of glass, that are exposed to extremes of water pressure. The most convenient consists of a watertight metal framework which is so devised that a sheet of window glass, that side up and 43 by 46 inches in size, can be inserted between its top and bottom surfaces. There are special rubber grommet rolls that fit snugly against the edges of the glass and prevent any water from leaking away.

After the specimen of glass is in place, a small square about one-quarter of an inch in thickness is left directly above the glass. It is minutely in a central glass tube which widens out into a funnel about 24 inches above the surface of the framework. A rubber hose from an adjoining water faucet provides a water supply which can trickle into the tube and fill the space above the glass. The water is allowed to run until its pressure is sufficient to break the sample of glass. A pane of glass three-sixteenths inch thick and 43 by 46 inches in surface area will break in pieces when the water in the tube attains a height of 14 inches. The glass will deflect one-half an inch before it breaks, so the Government tests have shown. A special recording map is used to register the amount of deflection in each of the experiments. The action of the water and the pressure it exerts as the glass breaks, say when the water attains a height of 14 inches in the central tube, are the same as though the glass surface was covered with a solid sheet of water 14 inches high.

More than 1000 samples of plate and window glass—specimen sizes two inches wide and 10 inches long—have been crushed to date by these devices. These tests are used in measuring the transverse and lateral strengths of the glass specimens. The first outfit is so



More than one thousand valuable plates have been shattered in the crockery strength test.

arranged that the sample of glass is laid flat side up, with the two ends of the glass supported and a saddle attached to a scale bar suspended over the unsupported center of the specimen. A shot bucket is attached to the free end of the scale bar and so adjusted that when the trigger is tripped, shot from an adjoining shot tower will stream into the bucket. The shot pour into the bucket, in each instance, until the weight on the scale bar is sufficient to break the glass. The instant that the glass breaks, the shot bucket falls on a lever and automatically stops the flow of shot. The amount of shot in the container is weighed, and this weight is the index to the transverse strength of the glass sample.

The arrangement of the other apparatus is such that the strip of test glass is laid against a weight flat side up. A metal ball attached to a pendulum arm is drawn back a certain distance and then released and allowed to catapult against the glass. The process is repeated until the glass breaks. There is a graduated scale in stilled along the path of the pendulum so that the arc through which it swings can be measured each time the ball descends. The lateral strength of the glass specimen is ascertained in this way. The ball and pendulum scheme of destruction is also used in testing the durability of plates, cups and tumblers. In each case the piece of glassware or china is held against a heavy iron weight, the pendulum ball is drawn back and then dropped so that it smashes against the article of crockery. The test is continued in such case until the dish or glass smashes into smithereens. The cups and glasses are always held against the weight in such a position that their bottoms are exposed to the blows of the swinging ball.

In testing the ability of different kinds of glassware and china to withstand regular and routine sterilization, the individual pieces are exposed for five successive periods to boiling water, and thereafter they are completely immersed in a closed vessel having a small steam vent, so as to be heated continuously for six hours. In this manner any data are obtained which indicate how the different dishes will stand up in restaurant and hotel service where mechanical dish washing ma-

chines are used. Study is also being made of the cobwebs of cracks which sometimes develop in china of inferior manufacture after it has been in use for a little while. The laboratory tests which have been made up to this writing indicate that American-made china and glassware are superior to the imported dishes and tumblers which heretofore have been purchased from French and German manufacturers in rather large quantities.

Dish breakage expenses are always heavy at leading hotels in this and other countries. A prominent Chicago hotelier reports that it costs more than \$25,000 annually to replace the dishes that are broken. Other hotels estimate an annual loss of at least 20 per cent of the original cost of their total supplies of china and glassware. The fact that dish breakage is such an important factor in the book and loss items of the average hotel explains the great interest and the cooperative assistance of the American Hotel Association which is aiding Uncle Sam in every possible way in his investigations. In fact, at present eight of the leading hotels of the United States and Canada are running service tests of French, German and American china. If these actual wear-and-tear experiments duplicate the results of the Federal laboratory tests, the swan song of imported china for hotel use in this country is about to be sung. There is every evidence that the findings of the practical hotelkeepers will coincide with those of the Government scientists, that there is no crockery or glassware in the entire world the equal of that which is now made in the United States.

Stucco Investigation

FOLLOWING several years, the Bureau of Standards has been studying stucco, and many of its findings have been embodied in a "Revised Manual Practice for Port and Cement Stucco" which was formally adopted recently by the American Concrete Institute as one of its standards. The practice covers the application of stucco to all uses, and although a masonry beam is probably capable of giving the most dependable results, it is recognized that there has been and probably will be for many years to come a larger use of stucco on frame houses than on masonry structures.

The application of stucco to frame houses involves greater uncertainty in results than on masonry bases, and in order to solve some of these problems the Bureau proposes to carry out, in cooperation with some of the interested trade associations, a study involving about 20 test points on the stucco test building. Considerable interest has been shown in this work, and a conference will probably be held in the near future. If the full cooperation of the interests involved is secured it is planned to start work early in the fall.



Left: Lower pane of window glass, 43 by 46 inches, is tested on this apparatus in which water pressure is used to simulate wind pressure. Center: Two inch wide glass, 10 inches long, is tested on this apparatus in which water pressure is used to simulate wind pressure. Right: Powerful testing machine, capable of exerting a pressure of 100,000 pounds if necessary, is used in determining the strength of the strongest of glass.

Various ways in which the Bureau of Standards smashes glass to learn its strength.

A Novel Use for Sugar-Cane Waste

SINCE the beginning of the sugar industry it has been the custom to use the waste products in a manner which is far from advantageous. Each year the sugar world produces an enormous tonnage of residual molasses, and an enormous volume of refuse alcohol cane. Neither is of any value as a source of sugar, yet the financial success of sugar raising largely upon their economic utilization in some way.

It has been customary to burn the bagasse, or refuse cane (also known as musard), sometimes as fuel and sometimes merely in huge piles, as the easiest means of disposal. It will burn—and that is about all that can be said for it. It has a moisture content of over 45 per cent, and this must be largely evaporated in the flames before combustion can proceed effectively. Moreover, when used as actual fuel, it causes much scale in the boiler tubes and forms many clinkers, in addition to the excessive losses of heat.

The molasses, on the other hand, can be converted into a rather high grade fuel and the ash from its burning is the finest sort of fertilizer possible for application to the sugar fields. If it were burned instead of the bagasse the latter would be available for other uses, with a large loss of the finding of these.

Hawaiian planters are finding at least one use for the waste filter which is extremely interesting. Obviously some sort of paper can be made of it as of all plant fiber. This is done and the resulting product, "mulch paper," is used in the fields, being laid in strips over the rows of young cane. As the cane grows, its tips penetrate the paper, and the sugar crop suffers no shading or diminution through the paper's presence. But the weeds that infest the sugar field find not the sharpness or stiffness to penetrate the paper, and they are completely eliminated, so far as the portions of the field close to the sugar plants are concerned.

A large plantation just prepared for the growing presents a striking sight, as our photograph indicates. The fact that the bagasse can be thus utilized, with very large benefit to the crop, will doubtless lead to the experimentation now in effect a substitution of the molasses for the waste cane as fuel, thereby completing the cycle of twin twentieth century sugar-planting economy.

A New Silver Which Does Not Stain

NEW metal resembling silver has been introduced recently in Great Britain and, according to a little trade paper, it has alarmed many retail jewelers. They seem to fear that the demand for the new metal may render their stocks of silverware less salable.

The name of the new silver is "Rhincan." It is the result of experiments to discover a method of making silverware which cannot tarnish in ordinary use. The new material is said to be as hard as steel and as strong as steel, which is described as an original and complex alloy. While not absolutely stainless, Rhincan retains its luster to a remarkable extent and is said to show no fine marks at any stage of making up. The new alloy is pointed to as a probable a relief for the household stuff that the periodical cleaning of the domestic silver. To maintain its brilliancy, the only attention required is an occasional rubbing with a clean chamois leather or a soft cloth. Specimens so treated are reported to have a finish almost equal to new silver, which have undergone no other treatment over periods

up to two years. The material is said to be proof against atmospheric oxidation and not affected by food salt. There is no need for glass linings in salt vessels made of this material.

As supplied to the manufacturing trade, the metal is ductile and can be stamped, spun raised, forged or drawn. The endurance of its color and brilliancy over long periods depends upon the proper conditions of working and involves some slight variations from ordinary methods. The new material is put to sturdy

corrections are to be made its unyielding attitude may be considered a disadvantage.

Charles, noise and various photographic productions of the Federal Government are frequently subject to changes even after they have been engraved. These corrections heretofore have been made by a cumbersome and time-consuming method involving the securing of the type and setting it with a hammer on an anvil designed for the purpose. The division of charts of the Coast and Geodetic Survey, United States Department of Commerce, sought to devise a more ready way of making changes on copper engravings of the Bureau of Standards was selected, and the director of this Government agency assigned W. H. Bailey a commission to study the problem. The efforts coupled with the aid of the machine and electrolytic sections of the Coast and Geodetic Survey have been fruitful of results. Apparatus is now being built for correcting electrotype in accordance with this discovery.

By Lester Jones, director of the Coast and Geodetic Survey, describes this method of correcting engraved plates somewhat in detail. The statement is as follows:

"The explanation lies in the adoption of an interesting, and it is believed novel, adaptation of the galvanoplastic method of electrolyzing by means of which it is possible to remove quickly and accurately the surplus of the plate to the depth of the engraved work, thus clearing the initial for subsequent engraving."

An electrode is fastened to the plate, and a fine stream through which a solution of copper sulfate is thrown under pressure against the plate in the place where the correction is to be made. An electric circuit from a generating source is formed between the plate and the electrode. In the plate, the electric current flows, and the action is very rapid. Its making the plate the positive electrode, copper is removed from it to any desired depth. The adjoining portions of the plate which it is not desired to correct or alter are not affected since they are filled with ink or any nonconducting substance.

"This treating method is dependent upon the fact that the engraved film is made by the use of a hammer on the back of the plate. The deeper areas are more heavily worked and, after polishing, the plate is ready for the application of new work which ordinarily will be engraved upon the clean metal to hand."

"Although the solution after striking the plate flows over it the only point affected is that against which the stream is directed. Small areas of the surface are quickly renewed as the engraved lines are not cut deeply."

"The removal of about one-twenty fifth of the thickness of the plate usually removes all work likely to need correction. After this deepening of the plate is completed it is filed in on the back by using the same process with the direction of the current reversed."

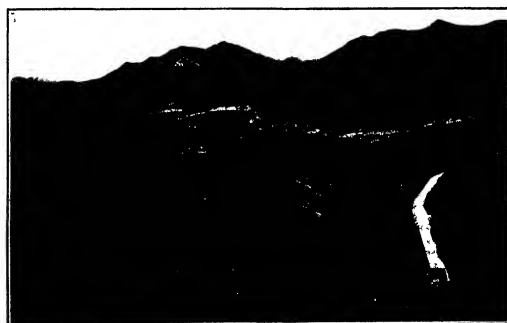
As indicated above, the electrolytic action is rapid. An area about two inches square can be removed from a plate in the depth of a few minutes. The method is therefore a more rapid and accurate than any method heretofore used for the engraving of the engravings, rather than in the engraving.



Sugar field with mulch paper strips, showing how the cane pierces the paper, and how completely the weeds fall to do so

recommended for sports and fairs, especially fancy patterns in which, when made of the ordinary silver copper alloy, the presence of "free" gives so much trouble. When melted under proper conditions Rhincan is said to make satisfactory castings smooth and free from pin holes. The details of the metal being more exactly reproduced than with ordinary silver.

The inventors have been hampered in their work by the necessity of producing an alloy which is suitable to carry the soft lead mark denoting standard quality. The minimum proportion of silver to qualify for this mark is 92.5 per cent, so that all the work has had to be concentrated upon the slight margin of 7.5 per cent of alloying medium. "Rhincan" cannot be used as much in the electroplating bath. The cost at present is about 30 per cent higher than that of standard silver, but



The extraordinary banded appearance of a freshly planted sugar field, with mulch paper strips laid in long down the rows

strong hopes are entertained that this figure will be lowered as experience is handled, the alloy is gained

CORRECTING ENGRAVED PLATES BY NOVEL METHOD

INVENTORS and printers, and their number is legion—throughout the United States will be interested in a new and improved method of correcting engraved plates, or "cuts," as they are popularly known. The permanency of the engraving contained on the electrolyte is one of its strong virtues, and yet when

it is transferred to the printing press, it is often found that the engraving is not perfect, and it is desired to correct it.

As indicated above, the electrolytic action is rapid. An area about two inches square can be removed from a plate in the depth of a few minutes. The method is therefore a more rapid and accurate than any method heretofore used for the engraving of the engravings, rather than in the engraving.

Why Armored Suits Fail

Some Facts Worth Knowing Regarding the Perforating Proclivities of Armor-Piercing Bullets

By Captain Edward C. Crossman, U. S. A.

EVERY one in a while or even more frequently than that, there comes out a hopeful gentleman who has discovered that certain forms of alloyed and heat-treated steel will stop most bullets. Having looked up the various known his purpose which he to try to sell the idea to the public, or to the Army or other organization of which the gentleman is likely to serve as target for luncheon.

Like altogether too many inventions, the armor suit gentleman is little informed as to the ramifications of the problem they think they have solved and they do not realize that others have likewise invented armor suits which fail.

The Ordnance Department of our Army used to have a special officer devoted just to "shoot away" the inventors of armor suits or armor shields for our soldiers during the war.

The little joke alluding to the armor personal protection by in the fact that like armored ships and big guns, neither side stayed ahead very long. Another one was that steel armor suits were as much as somewhat stiff and heavy, not to mention the armor feature that the other side in the war could drill holes in the best one ever made, putting a different type of cartridge into a plain infantry rifle.

The armor-piercing infantry rifle bullet would not only punch behind the armor suit forms of armor developed in fixed trench warfare, but in addition the armored tanks and other protection in fighting airplanes.

The United States and an armor-piercing bullet before the Great War, and I shot it for trial before Germany commenced to defend the Fatherland in Western France.

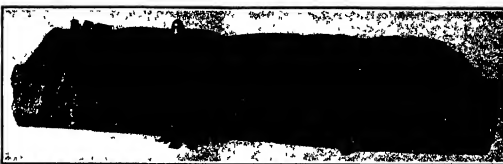
Early it was evident that a steel of special heat-treated steel, one-half inch or less, would stop an ordinary jacketed bullet, but alas, it would not even discourage the armor-piercer. So armor for modern soldiers looked down to the first need on tanks, to the massive and unwieldy German trench helmet covering head and neck to the strongest helmet, and to the special bullet used for snipers.

The armor-piercing bullet is practically the same as used by all armies. It consists of a miniature bullet, about 22 inch in diameter, which is shorter than the bullet in which it is going to be used and heavier and thicker than any steel likely to be familiar to the average man. It will weigh in the 20-grain bullet, from 80 to 100 grains.

It is set in a regular leaden core and that in turn is in the regular up-pipe of the ordinary armor-piercing bullet. There is thus a miniature 22-caliber very hard steel bullet, surrounded by thin leaden walls, and then in turn to the regular bullet jacket. The leaden walls permit "give" enough to the bullet to seal the hole of the rifle against gas escape, and to take the rifling and spin the bullet. Outwardly, such bullets look like any other except that they are longer than the standard and seem light for their length.

On striking armor the jacket mounds in like the lead disappears in a fine spray, perhaps acting as a lubricant for the steel bullet within, and the steel core slices through an inch-thick steel thickness of the hard test steel.

With the Clay bullet, in ferrier to the present armor, I have shot through a 5/16-inch plate steel—but not armor—plate at the range of 700 yards. But



An inch of mild steel, with an armor-piercing core of the old-style, light-weight type, protruding. Modern armor-piercing cores could readily slip through.

bullet as the familiar 30-30 used by hunters not equipped with more up-to-date armor will not even dent the plate at this distance.

The hole made by the armor-piercing bullet is, of course, merely the diameter of the core or miniature bullet. In the case of our own, it is about 22 caliber or less than one-fourth inch. Men behind the steel armor would therefore have only 22-caliber holes punched in them by the hard little missile. Such a bullet will easily punch through a full inch of ordinary mild steel.

One of the tests made at the Small Arms Ballistic Station was to obtain the ballistics of our new armor-piercing bullet, and incidentally we tried it against some of the armor plate on hand at the station.

One type had the miniature bullet or core, as it is known, made of 17th steel and steel, and the core itself weighed 80 grains. The other had the core made of a tungsten alloy, weighing also 80 grains.

Using special heat-treated armor plate sixteenth inch thick, the first bullet put one core nearly through, sticking in the rear of the plate, while the other two tried, broke the back of the plate. The tungsten alloy tried, broke the back of the plate. The other two were punched three clean holes through the plate. At 200 yards this tungsten core put a bad bulge in the rear of the plate, but did not get through. At 300 it also bulged the back of the plate.

The complete bullet weighed 180 grains, as compared with 150 grains for the standard 30-caliber bullet, and was given a muzzle speed of 2550 feet per second compared with 2700 feet for the standard bullet. Both were, of course, to be used in the regular infantry rifle and machine gun.

You can imagine, therefore, what use an armored soldier armed with our new bullet could make. More than half an inch in thickness can be easily penetrated by a little bullet any soldier may be carrying in his belt, meaning that steel plate a half-inch thick weighs about 20 pounds to the square foot.

Modern high velocity sniping rifle bullets will punch through a surprising amount of ordinary mild steel or boiler iron, and the higher the velocity, the greater the penetration. Weight of bullet seems to cut little figure. The little 6.6-grain .220 Savage bullet, for instance, will punch a hole through a half-inch mild steel plate, where the 220-grain "Krag" bullet won't begin

to get through. Always the hole made by these high-velocity bullets is much larger than the bullet itself, and it does not seem to matter in penetration whether the bullet is "soft nose" with the lead exposed at the point, or is full-jacketed with compressed lead or copper. I have seen a bullet of .28-inch caliber punch a hole through half-inch steel, and the diameter of the hole was three-fourths inch instead of less than one-third, as was the bullet.

No while light armor might stop pistol bullets or those from low-velocity rifles, none that might be worn and carried round by a man could stop an armor-piercing bullet. Indeed, it is doubtful if these inventor's suits for policemen could stop even a high-velocity hunting bullet in the 3000-feet per-second class of velocity.

A Free Balloon Without Top-Valve

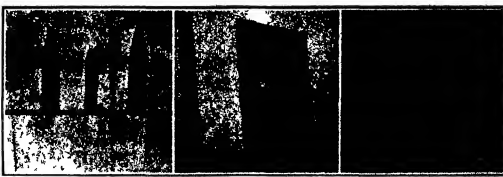
DURING the 140 years since Montgolfier invented the free balloon, comparatively few important improvements of the invention have been made. It is true, that from the original French balloon, a number of balloons, more or less cigar-shaped, filled with hydrogen or helium gas and equipped with motive power, have been evolved, but there have been no really important changes in the free balloon. It is still of approximately spherical form, and a big escape valve at its apex, its rippling line and its rope harness are the same as the balloon of gondola is suspended.

At last there seems to be a prospect of a material improvement by abolishing the clumsy and troublesome escape valve which rarely functioned properly and frequently was a source of great discomfort or danger to the aeronauts. When it rained, water would accumulate in the seat of the valve and run down the filling tube and on the heads of the occupants of the basket and their instruments when the release cord was pulled. In cold weather the felt packing would freeze, making it impossible to open the valve, or to close it after it had been opened.

In a recent German invention the hinged top valve is supplanted by a flexible tube, which is secured to the equator of the balloon to the filling tube at its lower end. The tube normally rests on the inner surface of the balloon, passes without any opening or hole through the opening in the balloon tissue at the equator line and has outside of the balloon, an extension consisting of a piece of very light material, which is attached to the inflow end and is provided with a perforated metallic self-sealing tube which prevents the mouth of the tube from being compressed and closed by the weight of the gas in the balloon. The stiffened end of the intake normally extends well down into the filling tube, but may be raised by a line running over a pulley on the pole of the balloon to any desired height. When this is done, the gas below the intake end of the tube will escape. The result of the released gas will cause the free end of the felt tubing to flare outward, thus indicating to the aeronaut that the tube is in proper working order.

Another valuable improvement, also by a German inventor, consists of a small elastic gas bag communicating with the balloon and provided with a whistle which gives a shrill sound when the rising of the balloon causes an increase in the gas pressure and makes release of gas in order to descend.

Both balloons described were launched on a test flight on October 2nd under actual flight conditions and were found to be reliable and reliable.



Left: An old-type armor-piercing bullet and the steel core. Center: Steel plate one inch thick, armor-piercing bullet of .28 caliber, and three-quarter-inch hole bored through plate. White strip is one-half inch wide. Right: One-inch thick mild steel, showing armor-piercing core protruding through it. Note how the core and the steel tend to weld.

Sundaring Eyes—A Film-Studio Problem

WHEN one exposes one's skin to the rays of the sun, one gets sunburned. These people are much more susceptible to this than others, but everybody is somewhat susceptible. The cause is found, not in the visible rays and not even in the radiant heat waves that accompany them, but in true light waves of such short length as to fall in the invisible, ultra-violet section of the spectrum. There have a powerful sun-baking effect upon the human epidermis.

The moving-picture industry finds itself confronted by a problem closely related to this question of sun-burn. The huge arc lamps used in the film studio, just like the sun, give out ultra-violet as well as visible light—the former comprising a very small percentage of the total. Hands and face get quickly accustomed to this, and immune to further burning just like the bronzed life-guard at the beach. But the eyeball is another proposition entirely. It is very sensitive to the ultra-violet burning, and it does not acquire immunity. The burning of the eyeball by the ultra-violet rays is a form of conjunctivitis. It is curable, but during the cure the patient must not be further exposed, and the eye is weakened by the fact of having been afflicted. This malady appears as freckles among motion-picture actors—and actors and actresses—thus it is called, "freckle eyes," has been called for it.

In response to the recent offer of one of the largest protecting companies, to pay \$5000 for a preventive measure that would not involve a complete overturn in the methods of film production, thousands of suggestions were submitted. A committee of scientists and practical motion-picture men considered these suggestions with the utmost care, and carried out a good deal of research and experiment in accordance with the more promising schemes put before them.

The experiments took two lines—medical and mechanical. There appears to hope for a positive medical preventive. A substance is known which, when put in the eyes, counteracts the bad effect of the ultra-violet rays. But with constant use this substance has a weakening effect upon the vision, and it must be used constantly, for the tears wash it off quickly. Besides, five hundred people cannot be depended upon to bathe their eyes, before each scene with any given substance—let alone one that is admitted to harm their eyes.

It is, of course, absurd to talk of glasses to screen the offending rays from the player's eyes. Many film people wear dark glasses with the utmost faithfulness while waiting about a set in which the lights are burning, but no star, and previous few extras, can wear glasses in the face of the camera.

This brings us to the proposition that the glasses be placed upon the lamps, screening out the dangerous waves and letting the others through. The difficulty here is that glass is very far from 100 per cent transparent, at its best. Plain window glass reduces the photographic ray 80 per cent, ground glass 40 per cent, and Pyrexine glass 20 per cent. If the camera man sets up a screen for the ultra-violet, it will therefore cut off so much of the rays that he needs in his business that he must use two lenses where before he used one only. He will then find that the two lenses with the screens will appear as much as one lens with a single lamp without the protective glass. This applies with plain glass, colored glass of any sort would obviously

make the matter even worse.

In view of all these considerations, it appears that the only way to solve the problem is in the solution, if there be one, lies in the film. A film would be needed that would work as effectively and as fast in a subdued light as the present films work in the glare. The laboratory men of the film company carrying out the investigation are now experimenting with a new type of film, in the hope of meeting this requirement. Whether they are immediately successful or not, in this direction, appears to be the only promise of relief for the film artist.

At present, two types of illuminant are employed in the motion picture studios, namely, the mercury vapor lamp and the flaming arc. Both generate a very large percentage of ultra-violet light which is highly active. The electric power consumed may run anywhere from 15 kilowatts to several hundred kilowatts for a single set.



The "cathodophone" transmitter, acting through direct sound-wave pressure upon the ionization current, without any membrane, etc., as in the microphone.

Long-Distance Concerts in Germany

GERMANY, which so far has deprived of the best of live radio music, has at last enjoyed her first radio music "concert" given, for those responsible for the demonstration found it for purely practical reasons—more convenient to use a transmission line for the first exhibition of their scheme, installing the aerials in the main wing of the concert building, rather than at a far away radio station. Anyhow, this concert, which our Berlin correspondent had the good fortune to attend, proved a conclusive demonstration of the possibilities of a decidedly new arrangement which it is hoped affords the definite solution of the loud-speaker problem.

However, even apart from the loud speaker, the scheme comprises a number of remarkable new apparatus, of which the more important are described in the following.

First, attention should be drawn to a novel microphone or "cathodophone," as the inventors, Joseph Mause, Hans Vogt and Dr. S. Ward, have dubbed it, and which is based on the following principle. An incandescent rod,



Group of the new loud-speakers, based upon the principle of the electrostatic telephone.

of that type, normal lamp, between the air surrounding it, i. e., makes it condense. When a small amount of this ionized air, the anode volume being about two to three hundred volts, an ionization current will flow through the anode the intensity of which is acted upon by any fluctuation in gas pressure in the neighborhood. If, for instance, the air in sound waves, caught in the filament thus superseding an alternating current corresponding to acoustic variations over the ionization current. The most remarkable feature of this alternating current is the absence of any harmful links, membranes, etc., as in the use of the ordinary or common microphone, and its being absolutely proportional to fluctuations in sound pressure. After being properly amplified it accordingly can be used for all purposes in connection with which a perfectly regular variation of sound and electric waves is required.

The second glow of apparatus is a particular amplifier, in the construction of which all active influences were eliminated, such as are usually liable from oscillatory circuits, having a period of the order of the range of sound frequencies. This is a low-frequency three-stage amplifier, the coupling of the elements of which is effected without any self-induction. It will supply currents of an intensity not higher than, say, 500000 amperes, such as the most sensitive telephone is barely able in perceptive, to about 10 watts of shunting energy, all frequencies low within the acoustic range, i. e., those varying from 50-5000, being dealt with exactly in the same manner.

It will be readily understood that in order to make this gigantic task special types of vacuum tubes had to be developed. In fact, the inventors have been successful in providing decidedly novel amplifier tubes, based on the use of silica, which possess a number of additional advantages.

The third apparatus designed by the inventors is a novel loudspeaker or stroboscope, as it is called, which effects an inconspicuously pure reproduction that any other type may give for radio reception. It is based on the principle of the electrostatic telephone, which, old as it is, has so far been absolutely neglected by electrical engineers, and which in the present case, proves especially valuable.

The new telephone is made of metal and silica throughout and is about 80 centimeters in diameter. The stationary structure of the instrument of diaphragms has substituted the membrane being divided into several concentric rings, so that any position of resonance is characterized by other liberty arrangements, is done away with. In fact, the new telephone within the range of frequency for which it was designed, covers all possible positions, i. e., no special position of resonance at all. There is thus within the acoustic scale no maximum and no material fluctuation in the intensity of reproduction.

The efficiency of the new electrostatic telephone is especially noteworthy, any iron and copper losses are well as losses due to stray currents, an loss payable from the usual no magnetic type of telephone, being strictly avoided.

An amount of energy of only about three watts, such as developed by a few pocket lamps, proved sufficient to fill one of the largest music halls of Berlin with such a volume of sound as to enable the musical performance to be heard with practically natural intensity even from the remotest seats. The quality of reproduction, of course, to some degree depends on the kind of instrument or in the case of music and recitation on the pitch of voice, but on the whole, the use remarkably satisfactory and immensely superior to those effected by the usual type of loud speaker.

It is interesting to note that the apparatus here described has been used in connection with a new sort of talking motion pictures, which it attracted a good deal of attention in Germany. Indeed the main filling of the picture in the past has been the lack of realism, and this improved apparatus should prove a forward step.

So the colored spectacles are the only means known to protect the eyes against the ultra-violet rays in the camera man's eyes; and these would hardly go on the film.

When Water Power Paves the Streets How the Town of Lawrenceburg Discovered a "Mint" on the Local Creek

By Lutell McClung

RIP indeed is the town or city that "reads money" for itself, yet this is just what the little community of Lawrenceburg, Tennessee, really does. The energy for such operation is generated by a large creek that flows close to the town, and the money-making equipment consists of a concrete dam, turbines, generators, transmission lines, electric pumps and water tower.

Many communities have these facilities. Yet it has remained for little but enterprising Lawrenceburg to demonstrate that a publicly-owned and honestly-operated water power plant can liquidate its municipal debt, pay for public improvements, and at the same time supply the people with light, heat, water and power at surprisingly low cost. Lawrenceburg is small, and, naturally, its water supply is small in proportion—less than 300 horsepower in all. But she has nothing to do with its significance. Hundreds of towns, and even a number of large cities could achieve the same results for their own citizens and their own citizens. If the follow the Lawrenceburg method. There is no longer any doubt that both public life and method are sound for everywhere concerned.

Not only does Lawrenceburg secure its street light and water for fire protection without charge, but the profits from its municipal hydro-power plant have paid off the old floating debt of the community. And, in addition, these profits pay for both street and sidewalk paving. There are no assessments and no taxes for paving, not a penny do the people pay directly for any of these improvements. The writer does not know of any other community that quite matches this.

Lawrenceburg is one place that has declared its independence of coal. If ever a single pound of coal were ever brought into the town, its "white coal" would continue to turn the wheels of its industries, illuminate the streets and supply water as well as light and heat the houses. Truly the small town itself does not buy coal of any kind. It never needs any.

While this progressive town is giving its citizens such service and improving its streets without tax or levy, it is selling current for power at 2 cents a kilowatt hour. It is selling water for 20 and 17 cents a thousand gallons. And with this low cost service and with the profits that accrue, there is still adequate allowance for the upkeep and operation of its hydro power plant and for the extension of service and interest on the money invested.

"This little project of ours is not simply a mint," says R. P. Nixon, its superintendent. "It goes right on working for the people as long as it pays out and with out any waste. It is permanent and we are all very proud of it. We have something to show visitors that other communities have not—just—just might have. What would it cost if we went back to using coal? I don't know. I don't want to think about it—we would run so deep into debt."

This money-saving, money making, service-giving little municipal plant is made possible by Rhoad Creek along which Davy Crockett, hero of the Alamo, once hunted bears and fought Indians. For many years Lawrenceburg was the home of this intrepid spirit, and it was from Lawrenceburg that he set forth for Texas and his last, and immortal, adventure in which he fell battling the Mexicans with the butt of his rifle.

There is an 18-foot dam 204 feet long on Rhoad Creek. From the dam extends a tunnel 10 feet square through solid limestone to an outlet on the creek lower down. The 18-foot high dam and the 18-foot fall in the tunnel give a head of 30 feet. The powerhouse and turbines are, of course, at the outlet of the flume through the rock. This little plant is located about three miles distant from town. During the day the power is used by industries—lumber mill, shuttle-black factory, creamery, ice plant, four mill, machine shops, garages, printing offices, etc. In the early part of the night the current, naturally, is taken by the houses. In the latter part of the night and in the early morning the energy from the turbines pumps water for industries and homes.

Thus the consumption of power is evenly distributed over the 24 hours and admirably balanced to meet domestic and factory needs. The water supply is a



The water-tower which is filled by electric pumps

in a number of dependable contracts for power. These demands steadily increase. Today, Lawrenceburg home owners not only enjoy low-cost lighting but a number have electrical heaters, ranges and other appliances for heating water, washing clothes and dishes, sweeping, etc. Yet their monthly bills for this service are so low because the power is sold honestly by themselves to themselves. Nobody secures the profits from this unusual enterprise but the citizens themselves.

In the profits began to accumulate and there was question of what to do with this surplus revenue. It was decided that it could best be spent in street paving. And so this work was started. It is well under way and will continue until all the broad streets are paved and other municipal improvements made. The town is growing rapidly and the streets will be extended and paved into new residential sections. The very fact that Lawrenceburg has cheap current for homes and industries has attracted many new residents.

As may be supposed, the time came when power demands were greater than the supply. Now the town is going further down on the creek to build another dam. This second municipally-owned operation will be interconnected with the first, and there will be sufficient power to take care of the new industries and residents. But the time will come when even this operation will not be sufficient for the growing population and new factories.

It is a growth, owned directly by honest, efficient municipally-owned hydro-power. The people realize this and are now looking beyond their second plant. They intend to go further away to a large power stream and there construct a dam whose energy will build a real city at Lawrenceburg. They have realized that a community can be built any where. If hydro-power is harnessed and distributed in the people for service and not for private profits.

The danger that has threatened several times is that of the plant falling into private or corporate hands, with the usual stocking and hoarding that builds up continuous interest charges and gives opportunity for enormous profits to a few individuals. There are dozens of towns in this country that are supplied by current generated from water power. But all except Lawrenceburg pay high prices for service and large and continuous profits to the corporations that are heavily capitalized and heavily bonded.

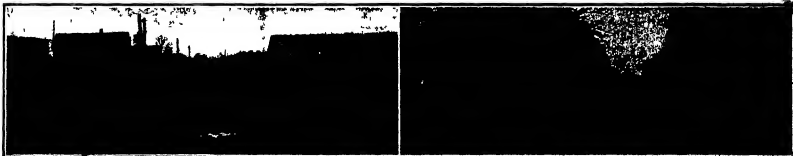
Lawrenceburg has fought safely through this danger and the people now would not sell their little "water-mint" to anybody for any sum. They realize that it is for its continuous and direct benefits to themselves, but for the example it sets to other towns and cities beyond where hydro-power is available.



Left: Power house of 300 horsepower, which supplies Lawrenceburg with power and light. Right: Dam for the power house, measuring 18 feet high by 204 feet long

have, clear spring just a short distance from town. There are installed two electrical pumps, overruling the power from the turbines two miles away and bringing the water into a large storage tank that gives necessary pressure for domestic and industrial uses and for fire protection.

When the Lawrenceburg plant was first established as a municipal operation it was an immediate success. For some time there were not many buyers of current. The town was in debt and the pessimists said that the cost of the plant only added to the debt. Entrepreneurs were offered to establish the project on a paying basis. The town agreed to wire houses and business houses and to supply electrical equipment at cost. This brought



What hydroelectric power, municipally owned and operated, did for Lawrenceburg. The first view shows the original state of the streets, while the second shows the present appearance of the residential streets



Large herd of horses on route across the Kanawha River

House-Moving by Ferry

SOMETHING different every day is almost certain to be the lot of the man who makes the moving of houses his profession. It is no longer a hard sight to see a large frame cottage traveling down the road or across the street, but a trip across a river is not so ordinary an incident in the life of a resident. Yet twelve frame houses in Charleston, W. Va., have recently undergone this experience. In order to obviate the necessity for moving them up or down, taking was built up to a height of forty feet on the barges that were to transfer them to the other side. The houses were then moved out upon this floating raft in the ordinary fashion of moving houses, and after being ferried over the stream, they were similarly shifted upon their new foundations.

The houses occupied the site that is being leased for the new State Capital, and their owners need a very comfortable sun in moving them to new locations in

against the cost of rebuilding. Thirty-two houses in all are being moved, but of these only twelve have been obtained to find new sites on the far side of the river.

A Machine for Sowing Seed by Hand

AMONG interesting German inventions of the past year period, few are more direct practical application than the new sowing device which we illustrate. Sowing machines are for the most part inclined toward size and complexity, for the small landowner or tenant farmer there has not been any very satisfactory alternative to hand sowing, with the irregularity of distribution that must necessarily accompany it. The sturdy agriculturist of our photograph, however, has only to hold his distributor steady with the one hand and grind slowly with the other to insure an even allotment of his seed until the supply in his bag is exhausted.



Hand-sowing of seed by use of a device that insures uniform distribution

The Rotary Plow

WHAT is the plow? Since thousands of years the farmer has been accustomed to regard it as necessary annual hoeing and rearing of the soil as being practicable on a large scale with one implement alone, the turnplow drawn by horses or power. Thus the word "plow" has come to denote an implement which is simply a combination of two self-acting knives and a moldboard whose varied form is designed to invert the ridges of soil cut from the land by the vertical and the horizontal knives.

But plowing does not always have to be done in this antiquated manner. Acting on a wholly different principle from the old turnplow which, however fully perfected during the last few decades, suffers from certain shortcomings that are fundamental, the rotary plow invented by Fletcher T. Hummel of Seattle, Wash., accomplishes the desired results, according to the claims of the inventor in a better manner. In addition it performs all the single plowing operation all the equivalent work of the several customary, seeded tillage operations, such as rolling, diskings, harrowing, pulverizing and, if desired, drilling, in the seed as it passes.

An inspection of the photograph of the rotary plow is quite sure to leave the impression that it is a kind of tractor, an impression given by the appearance of its forward parts. But as it draws nothing it cannot be called a tractor. It is complete in itself, in fact, for from driving any apparatus it is equipped with an extra rear wheel whose chief function is to hold the implement back so that the rolling drum bearing the turning knives or plows may be kept in the work of leveling up the soil in irregularities hitherto of deeply running furrows like any wheel without any driving.

The entire implement, which weighs 6000 pounds, is driven in a 45-horsepower gasoline engine of the tractor type. The disk, which is about 24 inches in diameter, is its fundamental part. This drum is caused to revolve at the rate of 172 revolutions in a minute, the disk, which is about 24 inches in diameter, is its fundamental part. This drum is caused to revolve at the rate of 172 revolutions in a minute, the disk, which is about 24 inches in diameter, is its fundamental part.

The diameter of the big drum is 48 inches, a size required for efficient work if the plow is to penetrate to a depth of 18 inches. And great depth plowing is one of the chief features of the new implement. It brings up at least six inches of subsoil that has never seen daylight, and it thus introduces not only a new method of hitherto unused soil but a controversial subject. The belief has always been prevalent that subsoil was so lacking in humus that the farmer should be very cautious in bringing much of it to the surface at any single year's plowing. It was frequently stated during the war that the soil of France would prove to have been ruined by the action of high-explosive shells in turning up the subsoil from depths of several feet. It would be non-productive. But regardless of theory, when the French farmer came to try crops on such soil, he found the soil so lacking of the humus that he discovered that the new yields were very much heavier than the old.

In the case of the rotary plow, which requires plowing to a depth of 18 inches and has penetrated to 38, checks taken between soil thus plowed and that done with the turnplow have demonstrated that crops have been more than doubled in some cases.

In milling the soil over, such as we have been cut away in the main time shown by the soil. It is very directly estimated. This exposes a very large surface to the action of plant roots and favors very greatly the absorption of plant food. It also aids the action of the soil without which crops practically cease to grow. When fertilizer and trash have been left on the surface they are incorporated in a far more thorough manner than is possible by ordinary plowing, and to a far greater depth than is possible by repeated diskings, giving a very uniform distribution from top to bottom.

The rotary plow is not intended for use in stony soil, where the blades are soon spoiled, but is at least in the great prairie where they are rare. In these lands grain has been grown for many decades without plowing much below three or four inches and this has given impression that the soil has been robbed of fertility. The new plow, however, is able to go deeper and bring up new humus, mixing them with the old so that no humus is lost and the soil consistency is little injured.

There are vast areas of unimproved lands in the West where the soil is stony. Usually these are covered with a dense overgrowth of shrubbery, flag and other vegetation that is very hard to turn under with the common plow. These, with their roots, the rotary plow is claimed to handle with ease. About as severe a test as any plow can be put to is the breaking up of an old, well-established prairie bed. These



The rotary plow that converts virgin soil into seed bed in a single operation

roads are very hard, very tough, and they present the soil in all directions. The rotary plow makes short work of them by turning the soil into small pieces and breaking them into the soil to decay and provide plant food.

Thus it is seen that new methods may be brought to be on an equal annual operation that for the average farmer is the most laborious of all the women's work, plowing—a task which has been in very much the same way since the first plow. It is very difficult to improve a machine of this great age, yet experience has shown that the American farmer is by no means slow to adopt new methods of doing things, even if it is a new machine, and to do the work as well as the old methods. The result, however, of the rotary plow stands in need of little comment. The rotary plow may result in such a change in farming as to eliminate the turnplow, just as the letter eliminated the creaked stick.

Making Lightning for Films

PHOTOGRAPHS of our readers are sufficiently sophisticated to realize that, when the movie man needs a flash of lightning in his action he does not have to wait for a thunderstorm to get it. Probably few of them, however, realize how simple and cheap the production of this lightning is. The wooden stand used for the purpose, which we illustrate, is wired just like an arc lamp. The two contact points are at the two upright arms—a single large carbon constituting the electrical circuit in the one case and several smaller ones in the other. Its pulling a cord the two contacts are brought together and the circuit is closed and when this is released and the circuit broken, there is a momentary flashing arc. The spreading out of the arc effect over the several small carbons in this contact is responsible for such of the real look of this brand of lightning.



Artificial lightning for the movies is produced with this simple arc machine



Left: *Kalmia latifolia* or broad-leaved laurel, which is sometimes mistaken for wintergreen. Center: *Delphinium ajacis*. Right: *Atropa belladonna*, the deadly nightshade. Three of its berries contain sufficient poison to cause violent symptoms.

Poisonous Plants of the Garden

Danger Which Lurks in the Pretty Flowers and Berries Picked at Random

By Dr. E. Dade

IF IS an armed time which exists between the plant and the animal kingdoms. Vegetables, especially the more luscious kinds, attack plants and voraciously gulp them down from leaf to stem. As a means of self-protection against such wild and unmerciful wholesale destruction many ingenious protective devices are employed in the plant and of these the more important are corrosive liquids and poisons.

Not only those substances which, in infinitesimal quantities, retard the animal organism fatally, but all those many chemical compounds which are injurious to the plant-eating animals are included. These, if taken, only form a very small part of the known toxic substances. Certain plants seem to contain well defined poisons, which, although they may be harmless to one animal, are intensely toxic to another species. Many plants are more or less protected by such secretions from total destruction through over-eatious animals, but the toxin cannot be considered as a protective substance since the plant does not produce it for this special purpose. It is only a product of metabolism and that the plant has finally changed this substance chemically for its own protection can hardly be readily considered, although much can be said in the support of such a theory.

In all probability each flower has its own poison—in its broadest sense—of which we know nothing, nor which we can recognize. Grating each mouth-dropper around and out the leaves. On the other hand, they certainly leave certain plants severely alone, although they live on reptile and even have the very special characteristics which would lead one to suspect hidden toxic properties. Something must be wrong with them, something must be wrong with our senses, but it may be that it is possible to the animal.

Plant poisons as built up by nature, chiefly composed of carbon, hydrogen, oxygen and often the inert nitrogen, a substance which in itself is very inactive and sluggish but united with other elements gives us not only health but also very harmful and dangerous compounds. Then, too, sulfur may be present, as well as a few metals, the most important of which is potassium, but these are quite rare in occurrence. This building material is also used for the formation of the entire plant, from grasses to the intricate mushrooms. Certainly it is a mar-

velous power inherent in the plant which enables it to produce all those materials found in it, the various poisons themselves only being a tiny fraction of the existing compounds.

The action of the different types of poison on the organism are peculiarly distinctive. Each one has its own symptoms. Some only react when they come in direct contact with the blood vessels, being fatal in almost infinitesimal quantities. Others have no, or practically no power under such a condition. They are most vigorous when they reach the stomach, where they produce the most serious disturbances.

Although poisonous animals are seldom mistaken for harmless creatures, such a definite classification cannot be given to the plants. In fact, a large number of them are similar to the most common of kitchen herbs and edible plants. Others, again, produce fruit, which, in appearance, seem to be tasty and delicate, but in reality are most dangerous. Such headlines as "poisonous underground cause death," and "children die eating poisonous berries" are only too often found in the daily papers.

No method is known by which the character of a poisonous substance can be determined. The only protection available is the personal picking of the wild species and the absolute irrefutable knowledge of the character of each individual specimen picked. Furthermore, two types of mushroom poisoning were differentiated one a narcotic and the other a digestive disturbance. Both symptoms often intermingled, the effects taking place a few hours after eating. There are a few methods by which the toxic effects can be removed. In all probability, all poisonous species can be rendered edible by first digesting in vinegar and salt, then boiling

for some time in water, and dissolving the boiled water.

Edible mushrooms sometimes produce symptoms of mushroom poisoning, especially when they are not used in their fresh condition. Mushrooms decay rapidly when they are not prepared at once, and the product of decay somewhat resembles phosgene. It is but at all infrequently that such decay is accompanied by a softening of the tissues and a disagreeable odor.

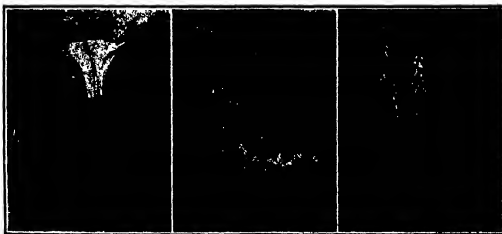
For more accurate than mushroom poisoning is poisoning through berries. Children often eat those of *Atropa belladonna*, the deadly nightshade. Even three of these berries contain sufficient poison to cause violent symptoms. This alkaloid strongly slows the action of the heart and stops the action of the salivary glands. It also affects the nervous system and causes violent delirium. The most characteristic symptom is its action on the pupils of the eye which it dilates.

The Jimson weed or thorn apple, *Datura stramonium*, was introduced by grapes who considered it their "peppermint" poison. Besides the toxic atropine, hyoscyamine, scopolamine and several other alkaloids are present. The latter two are found in still larger quantities in *Hyoscyamus niger*, the henbane, whose pale yellow flowers, profusely veined, appear in June and July. The entire plant is sticky and covered with hairs, and, despite a sweetish odor, is often mistaken for a kitchen herb.

Foxglove (*Digitalis purpurea*) and Jimson weed poisoning occur but rarely. In the latter case an indirect poisoning may take place. Large edibles like *Helleborus* eat the leaves of the plant with impunity, but when these berries are eaten, poisoning occurs. In a similar way the honey gathered by bees from the low-levelled laurel (*Kalmia latifolia*) is, under certain conditions, poisonous. Then, too, children often mistake the young shoots of this laurel for wintergreen (*Gaultheria procumbens*) and are poisoned.

The common nightshade, (*Solanum elaeagnifolium*), with its black toxic berries, which are often eaten by children, opens its small flowers during July, August and September. The symptoms are atropine-like, dimming, loss of speech, cramps, and the entire body is convulsed. The pupils of the eye are dilated and death often comes through a stroke.

In every case of poisoning a doctor must be called. In the meantime, until he arrives, it is advisable to give the patient acid and tannic or liquid containing tannin. Artificial respiration may be used and whenever possible revivify the lungs.



Left: *Datura stramonium*, or Jimson weed or thorn apple, which contains powerful alkaloid poisons. Center: *Solanum elaeagnifolium*, which has black toxic berries often eaten by children. Right: *Digitalis purpurea*, likewise known as fox glove.

Slipping Railroad Coaches to Save Time

THE capabilities and requirements of railway travel vary in different countries in many respects, and to an extent that would surprise the uninitiated. A few words explaining the reason for the slipping of passenger coaches on English railroads may therefore not be amiss.

It sometimes happens, in the case of a long-distance, non-stop run to a certain destination, that a full train of cars is not required, in other words, that there is no power to spare. It also happens that, while it may be expedient to maintain a certain service to other stations, either intermediate or on branch lines, traffic requirements would not warrant running separate trains long distances to such destinations, as frequently as is desirable.

The object of slipping coaches is, therefore, to divide an express train, while traveling at full speed, into two portions in such a manner that while the front continues its journey unhindered, the remainder, under the braking control of a guard, can be slowed down so as to stop at a predetermined point, where it is taken to by another locomotive in waiting, thus saving some ten minutes loss of time otherwise entailed by stopping the whole train.

This method is employed by a number of English railroads, notably the Great Western, the Great Eastern and the North Western Lines. It is effected so easily that passengers in the slipped portion of a train, alight when it stops, have no idea that the locomotive with the front portion, is speeding on its journey several miles ahead.

Before describing the mechanical details of the slipping system, it should be mentioned that the English method of coupling railroad vehicles is quite different to the automatic system employed in America. One of our illustrations is that of the standard British form of coupling. At each end of every coach there is a draw bar ending in a hook, and through a hole in the shoulder of the hook a shackle is issued, from which depends a union screw with a screw hook at lever. At the other end of the union screw is another branch line. To couple two coaches together, the union screw of one of these couplings is lifted and pushed over the screw hook on the other coach. The lever now is then tightened up by hand until the buffers of the two coaches are in firm contact.

There are several different types of slip couplings in use, of which it will be sufficient to describe those employed on the Great Western and Great Eastern railroads in England. In these the drawbar is formed in two portions which are hinged in a vertical plane on a horizontal pin, so that when free the lower portion swings downward, but when fixed it serves exactly the same purpose as an ordinary drawbar hook. It will be seen from our illustrations that the end of the movable portion of the hook is formed so that, when in use, it takes an inclined seating on the shoulder, the upper edge of the end lying horizontal and flat, with a jacking on top of the shoulder. Behind the latter is an inverted U shaped strap secured to the shoulder so as to

leave a hole or slot above the end of the hook. In this slot, a horizontal case-hardened locking bar is fitted, extending to the inside of the guard's van where it is pivoted to a hand lever, the upper end of which may either be held in position by a pin or secured by a spring catch in the side of the quadrant.

To couple up the vehicles, the lever is pulled forward, thus withdrawing the locking bar and allowing the hook to open out. The ordinary coupling shackle of the other coach is then lifted into position, the hook is lugged back round it, and the locking bar is shot forward, thus effectively securing it.

To slip a coach, the guard first closes the locks in the brake pipes, and then pulls forward the lever, thereby releasing the hook which falls back and immediately the shackle in the coupling of the other vehicle falls out, and the whole coupling swings downward, thus severing the connection completely, so that the rear coaches begin to lag behind those in front, which run time their journey with unabated speed.

The slip coupling should at least as readily be applicable to the American type of automatic coupling as to the English type.

Take the case of the automatic couple on vestibule coaches, operated by a lever under the coupling assembly. It is only necessary to introduce a few bell cranks and other levers, in lifting an lever in the guard's van similar to the English type, to render



Slip coupling in use on Great Eastern Railway in England, shown closed.

quick measuring when expressed in meters. Thus the number of radio messages that can be transmitted simultaneously without interference can be correctly judged from the kilocycles but not from the meters. For example, the meters will in the future work in a band of wave lengths from 150 to 200 meters, but this band of wave lengths from 2000 to 1500 kilocycles. This is an enormously wide band when considered from the viewpoint of kilocycles but for example the band having the same width in meters from 1000 to 1001 meters, which is 900 to 200 kilocycles. While it is possible to carry on 50 simultaneous radio telephone conversations between 150 and 200 meters, only one could be carried on between 1000 and 1001 meters, because of the smaller range of kilocycles here.

In accordance with the recommendation of the Second National Radio Conference the Department of Commerce and other Government departments will hereafter follow the practice of expressing its own values of kilocycles rather than meters. The conference room needed the practice of expressing wave frequency in kilocycles per second with wave length in meters in parentheses thereafter. The relation between the two is very simple. For approximate calculation to obtain kilocycles, divide the number of meters by 1000. To obtain meters divide 300,000 by the number of kilocycles. For example 100 kilocycles equals approximately 3000 meters, 300 meters equal 1000 kilocycles, 1000 meters equal 300 kilocycles, 3000 meters equal 100 kilocycles. A table which may be used for rapid and accurate conversion either from kilocycles to meters or meters to kilocycles may be obtained by addressing the U. S. Bureau of Standards, Attention Radio Laboratory, Washington, D. C.

Types of Aeronautical Instruments

THE Bureau of Standards has issued Technical Paper No. 237 on "Types of Aeronautical Instruments." Copies can be obtained from the Superintendent of Documents, Division of Printing and Office, Washington, D. C., at 20 cents each.

This paper describes the various instruments ordinarily used on an aviation aircraft and will be found useful to all those interested in the aeronautical instrument art. The instruments considered in this paper are as follows:

Altitude instruments, including altimeters, barographs and altimeters; speed instruments, including air speed indicators, ground speed indicators and airspeed indicators; orientation instruments, such as compasses, turn indicators and inclinometers; engine instruments, among which may be mentioned instruments which are used to indicate the number of revolutions of the propeller, pressure gauges, manifold pressure, manifold air pressure and manifold temperature; navigating instruments, including maps, dead reckoning instruments, astronomical instruments and the radio direction finders.

Among the special instruments and accessories described in this paper are oxygen instruments, recording instruments, strut and gas temperature thermometers, the strut thermometers being used to indicate the temperature of the surrounding air while gas thermometers are employed on lighted aircraft to give the temperature of the gas in the bag. Other instruments described include clocks and watches which are carried on nearly all aircraft and which must be capable of withstanding shocks of landing and severe vibration, manometers and hydrides lock devices, employed entirely on lighter than air craft to control the pressure of gas in the bag and to indicate leakage.

The paper is profusely illustrated with photographs of the latest types of aeronautical instruments.

Slip coupling, shown above, in the open position, with link released and out of picture.

the slipping of coaches on American trains a very simple operation indeed. And it is on its face a very profitable one. It is indulged in so freely in England that, when one takes an express train from any of the large London terminals, it is a very essential thing to make quite certain that one is in a car destined for the train to which one's ticket refers. Failing this precaution, one is likely to find oneself prematurely situated off the main line, or carried past the station to which one should have been situated.

Use of Kilocycles in Radio

THE Second National Radio Conference, which I held last March, introduced a method of designating radio waves, which is somewhat new to the radio public. This is the use of frequency in kilocycles (abbreviated *k*) instead of wave length in meters. The advantages of this practice have been familiar to radio engineers for some time, and it is probable that it will eventually replace the use of wave length in meters. As a matter of fact, wave length is a somewhat artificial device in the handling of radio apparatus and is one of the difficult things for the beginner to understand. The frequency of the radio wave is the same as the frequency of the alternating current which flows in the radio transmitting or receiving set.

As often happens in technical matters, the idea of "kilocycles" is in the line of the forbidding aspect of the word suggests. "Kilo" means a thousand and "cycle" means one complete alternation. The number of kilocycles indicates the number of thousands of times that the rapidly alternating current repeats its flow in either direction in the antenna in one second. The smaller the wave length in meters, the larger is the frequency in kilocycles.

The reason that kilocycles are coming into use and displacing wave length is that the frequency of the frequency of transmitting stations to prevent interference is the same, no matter what the frequency may be. This necessary separation is variable and

End of one coupled for slip coupling. Note the link which engages with slip coupling shown in other views.

The Wembley Park Stadium

Built in London, the Largest Sports Arena to Date, with a Capacity of 125,200 People

By P. J. Rudon

LANKS to the courtesy of the management, we have been enabled to compile from first hand information some interesting particulars of Wembley Park Stadium, the greatest stadium and sports arena in the world, which has recently been completed in London at a cost of \$1,500,000.

The arena and amphitheatre buildings, with their immense accommodation for spectators and players, are occupying a total area of 1.2 acres. The seating accommodation provided for 247,800 new jurors under cover and a further 27,000 in the open, the total seating and standing capacity being 1,27,800—50 per cent greater than 18,000 credited to the Roman Colosseum though many authorities believe it is at least 50,000 to 80,000. In addition there is accommodation for the convulsions and comfort of 100,000 visitors, including dressing, unisex and bath rooms, restaurants, fully equipped with modern apparatus, and a large recreation room with billiard and writing tables. Access to the grand stands and to all parts of the stadium is gained from a wide elevated corridor, well enough for 24 persons abreast, with escalators at frequent intervals leading to all parts of the stadium. The following is an interesting comparison with the Colosseum at Rome

Colosseum	Wembley Stadium
220 ft.	320 ft.
220 ft.	320 ft.
220 ft. x 100 ft.	320 ft. x 220 ft.
	320 ft. x 220 ft.
	320 ft. x 220 ft.
	320 ft. x 220 ft.
50,000 to 80,000	125,200

The outer wall of the stadium, built a mile around is carried on 37 arches, each 45 feet high and 50 feet span. The structure is built almost entirely of steel and concrete and comprises 40 miles of terracing. Although there is little risk of fire, ample provision is made to cope with an outbreak. In the north front, overlooking the exhibition grounds, are two concrete towers 100 feet high each surmounted by a reinforced concrete flagstaff.

The arena of the stadium—the area occupied by the playing field and the running track—has been prepared under the supervision of Mr. Charles Perry, who has been responsible for the construction of all Olympic playing fields and tracks since the organization of the Olympic games in 1906 in Athens.

It was decided to deal with the stadium at Wembley in very much the same way as that at Stockholm had been treated, and that the foundation of it should be on a depth of ten inches, in a natural drainage system. To this end a fall was allowed for, from the center of the arena to the outside edge all round the playing field of at least six inches, to allow the water to run away.

On the clay foundation, various grades of children and planks and were laid in a depth of ten inches, and over this again five inches of special prepared soil was spread to form the natural bed of the turf.

Wembley Park, before it was taken over by the ex-

hibition authorities, had been occupied for 12 years by the Wembley Park Golf Club. In April, 1922, when the exhibition authorities took over the park from these owners, as many of the drainage and putting greens as could be spared by the contractors were ruled off, and put under cultivation. These greens were dressed, rolled and cut, and generally treated, in order to produce by September the very best turf possible. On September 6 a large portion of the arena was ready for tarring, and the cutting and transferring of this

from the major axis of the stadium to the running track, and then, in addition, there was a drop at each end of the arena from the center to the ends, which the goal posts would be placed, toward the track.

There are two running tracks, one skirting the playing field being a circular quarter-mile lap, while the other gives a straight 220 yards apart. The straight is made possible by tunneling under the west-end bank of the stadium, so that the runners will be the distance out or slight, but will emerge from the 80-yard tunnel into the full view of the spectators. Some of the more recent sports grounds in America possess this feature, but until now there has been no stadium in Europe with a 220 yards straight.

It is fully expected that the tracks will become the fastest running courses in the world, and that new records will be set up. In the "220 straight" the absence of corners or curves will be a great advantage to the athlete. He will not need to bend in with the curve of the course, and again, the races will be more truly run because the serious disadvantage of not being able to see the first corner is removed will be done away with.

The two ends of the stadium were very exhaustive. The first stage, by means of deep loads, was of a rigorous character. Various machines were selected and tested separately. The area of the first section tested was 86 feet by 35 feet. Five thousand bags of sand, each weighing one hundredweight, were placed on the seats, giving a total load of 250 tons. The seating arrangements of this section will accommodate 850 people whose total weight would be only about 60 tons. Thus a large margin of security was revealed by the tests, for the test load applied would have to be quadrupled before the structure would fail.

The iron load tests were carried out by 1200 selected ex-citizens, employees of the Royal Ordnance Works, and those who built the stadium. In company for the first time the men worked in the grand stands of the stadium to that section of the stands immediately behind the royal enclosure. Here they engaged in various movements—rising quickly on knees, sitting quickly, marking time, swaying from left to right, and forward and backward, cheering and stamping. These movements were repeated on other sections of the stands, and the heart reading tubes by the engineers during the test showed variations greatly below those anticipated when the plans were drawn.

Standard Boxes for Hospitality

THE textile section of the Bureau of Standards has nearly completed the development of standard boxes for packing laundry. This has resulted in the reduction of approximately 800 different sizes to about 10 standard sizes. The standard boxes will be made up in 10 standard and actual packages will be made up in 10 standard. This check determination, the project can be considered complete and it is expected that it will result in the saving of a very large amount of money to the laundry industry.



The live load test of the stadium by 1200 ex-citizens, who rose and sat down suddenly in masses, marked time, swayed from left to right and forward. Readings of the effects were taken

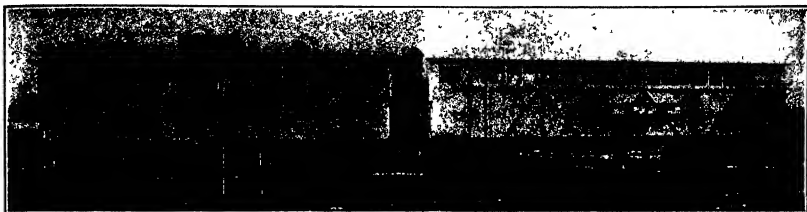
turf was begun. The turf was cut in downsides, 18 inches by 12 inches, and 2 1/2 inches thick, and these were placed on flat plates and taken by a small-gauge railway into the stadium. Here they were unloaded and relaid immediately. The grass never covered growing. The work was so organized that the turf was laid almost as soon as it was cut, and arrangements were made by which, on each day, no more turf was cut than could be successfully laid on that day. The turf laying was completed by October 6, and two weeks



General view of the Wembley Stadium along its longer axis. Overall length 320 feet, breadth 320 feet. The arena, 321 feet by 220 feet, may be compared with the Colosseum, Rome, which is 220 feet by 150 feet. Total capacity, seated and standing, 125,200.

later, owing to the excellent way it had been knitting, the grass had to be cut. The result is that there is now a football ground composed of a grass so tough, that it will withstand the wear and tear of a season's football and yet remain as green at the end of the season as at the beginning.

The arena is 100 feet above sea level, and stands on the highest point within the exhibition ground. The complete is heavy clay. The system adopted, therefore, was to prepare the foundation of the arena so that there was a drop of six inches in the clay formation



Two cars comprising the instruction train employed by a French railway for breaking in new men and perfecting old railway employees in their work

A Traveling School for Railway Men

IN solving the problem of breaking in new men into the ways and means of railroading, the Paris and Orleans railway of France has developed an ingenious traveling school, which forms the subject of the accompanying illustrations. This school consists of two instruction cars, permanently coupled together and provided with a telegraph, ventilator, so as to form a single unit. The cars contain a vast array of equipment for the handling of classes. One of the coaches is a typical French four-wheeled baggage car, while the other—an eight-wheeled affair—is known as an American type car.

Perhaps the most obvious feature of the traveling railroad school is the large collection of working models. On one side of one of the coaches there are various valve and driving rod movements mounted in such a manner that they may be actuated by a crank. A few moments' study of one of these models will teach far more than many hours' study of diagrams and text. Then there are models of the various types of compressed-air brake systems, with some of the parts broken away to facilitate study.

In one of the cars, suspended from the ceiling by means of cables, there is a table with a complex lay out of miniature tracks, switches and signaling system. This piece of equipment is employed to teach embryonic railway men the essentials of railroading. The miniature railway comprises four stations with double tracks, four stations with single track, many switches and cross-overs, and 187 various kinds of signals. The table is countersunk in such a manner that when it is not required it can be pushed up toward the ceiling and out of the way.



Typical model of compressed air brake equipment, with some of the parts broken away to show the inner workings

In fact the same idea is employed throughout so as to use the available space to the best possible advantage. Tables, hinged at one end can be folded down against the wall and out of the way when not in use. The breaking in of new men on railroads, or any

other public service enterprise where their unavoidable inactivity would constitute a menace to the life of the patron, is always a ticklish problem. It is one that cannot be avoided, however, and the French have made a very intelligent attack upon it.

Standardization of Wood Screws

AT least two systems of numbering wood screws to designate the diameter have been used in the past, methods of measurement, lengths have been hopelessly at variance, and the number of threads per inch for a given size has not been the same for different makers. All this confusion has been eliminated and the diameters of wood screws made uniform throughout the United States as the result of a cooperative agreement among the manufacturers, the Bureau of Standards and the technical section on Builders Hardware of the Federal Specification Board.

The system of numbering to be used hereafter is the same as that now employed in designating nuts. Screws also, except that diameters above No. 12 are also designated by numbers. This means, for example, that a No. 10 wood screw will have the same diameter as a No. 10 machine screw. Uniform methods of measuring diameter and length and uniform tolerances in these dimensions were adopted together with a standard angle for the under side of the heads of flat and oval head screws. The number of sizes of brass and steel screws manufactured as standard was reduced from 535 to 291, a reduction of 45 per cent, while at the same time retaining a sufficient variety for every need. This reduction should benefit the manufacturer, the dealer and the user.

Regular No. 110 of the Bureau of Standards showing this work has just been issued and can be obtained from the Government Printing Office at Washington.



1.—Miniature railway system with switches and signals for giving students the rudiments of railroading. 2.—Two of the working models of driving and valve mechanisms of French locomotives. 3.—An illustration only. The tables here are used to show the counter-rotated valves which secure it in any position.

Some of the equipment of the traveling railway schools which helps convert recruits into seasoned railroaders

When Wood Shrinks

What the Camera Has to Report Regarding the Changes Taking Place During Seasoning

By B. B. Borchers

Forest Products Laboratory Staff

THE film, and a picture camera and the microscope, with which the first moving picture was made, of just what happens to wood when it dries. For eighteen hours, continually every two minutes a stream, light focused upon a drying lot of red oak, laid out in a microscope focused on the small block of wood, the camera recorded each change as the wood sets up its moisture.

Dr. M. E. Dieter, photographer at the Forest Products Laboratory of the United States Forest Service, with the film which is only one of a series he hopes some day will be made.

Physicists have known in a general way that shrinkage and swelling always accompany a change in wood, and Dr. Dieter's film records graphically, continuously, and in a few minutes just how wood reacts during the long period of seasoning.

The piece of red oak used in this motion was saturated

with water. As the water saturation point, shrinkage begins. As the moisture leaves the cell walls, they shrink and draw the wood structure together.

The cell cavities, which were round at the beginning, become long and oval because the shrinkage of the walls of other woods, is considerably more tangential than radial.

The film brings out strikingly the phenomenon of checking. A small crack appears on the surface. The crack lengthens and widens until it seems as though it rapidly lengthens and finally becomes invisible.

Such cracks or checks, however, extend to only a limited depth and are a common occurrence in seasoning wood. The outside surface, which is exposed, naturally dries faster than the inside. As the wood shrinks when it loses moisture the outside tends to shrink less. The inside is still moist and expands so that the surface is held from shrinking. The stress that develops cracks the surface of the wood. As the

drying, even though the movement was only one one-hundredth of an inch, it threw the microscope out of focus. He overcame this trouble by putting a spring under the piece of wood to keep it snugly against the bands that held it in its proper position under the lens.

The same area of the wood, about a quarter of an inch in diameter, had to be kept under the microscope.

As the piece began to shrink, the area being photographed moved, and a new area came into view under the microscope. Dr. Dieter remedied this by placing a piece in the center of the piece of wood and beneath it the wood shrank toward this pivot, and so tended to move into the exposed view instead of out of it, keeping always the same portion of the block in focus.

Scientists at the Forest Products Laboratory hope that this practical demonstration will be particularly helpful to those who are using dry kilns to season lumber. Various pictures can be made that will show clearly the harm done to the structure of wood by too rapid drying, poor circulation, and other careless prac-



1 and 2—Little boxes of drying, changes the appearance of a small red oak block. In the first photograph the cell cavities are almost round, they become elongated as the wood shrinks, which then is clearly brought out in the second photograph. 3—Dr. M. E. Dieter adjusting his apparatus preparatory to taking motion pictures of the shrinkage of wood. The picture shows how the stress is placed above the micrometer. With camera and light are mounted automatically at regular intervals. 4—Change view of the red oak block held firmly in place on the microscope stand. The condenser at the left concentrates the light on the blocks. 5 and 6—A check in drying wood. The second picture of this pair shows it almost closed. This also shows how wood swamps lighter

Making the motion picture camera report the story of what happens to wood when it dries

with moisture at the beginning of the picture at the end of eighteen hours it was almost dry. As the moisture evaporated, the camera recorded the changes in the surface of the red oak.

On showing, of this film would convince anyone that wood must be seasoned carefully before it is fit to use. Pictures can be taken of each kind of useful wood, showing just what to expect when it seasons. For instance, a flat sawed red oak board that is twelve inches wide when it is green will be only eleven inches wide when it is seasoned or dried. The motion picture gives a clear idea of how and with its inevitable shrinkage occurs.

The red oak used for the motion picture film was small, about one inch square, and a number of an inch thick—and therefore it dried rapidly enough so that the changes could be noted in the camera. (Meanwhile, Dr. Dieter calls the method in which he took these moving pictures of actions that can be seen only under the microscope.)

The beginning of the film shows the cross-section of red oak so unmodified that the cell structure is plainly seen. After a time the moisture can be seen to disappear from the cell cavities as the wood dries.

When this free water has evaporated and the wood

inner portion of the wood dries the stress is removed, the cracks gradually close up, and the wood appears the same as before the checking occurred. Checks never actually heal' up, however, but remain as a permanent source of weakness.

The method by which this picture was taken at the Forest Products Laboratory is not new, although this is the first time it has been used for a study of the shrinkage of wood. The wood is focused under a microscope with the camera above, and exposure is automatically made by a make-and-break circuit that operates the shutter at the proper intervals.

To place a lot of wood under the lens and take many pictures in this manner sounds easy, but Dr. Dieter had to overcome many complications. In the first place, the light necessary for exposure produced so much heat that the wood dried too rapidly. It case-hardened—became hard and baked on the surface. To overcome this, Dr. Dieter had the light flash only when an exposure was being made—he accomplished this by a circuit similar to the one which operates the shutter. The heat developed by these intermittent flashes was much less than when the light burned continuously, and the wood did not case-harden appreciably.

Dr. Dieter found that when the wood shrank in

tion that are so common. Presented with such vivid proofs of the harmful effect of wrong practices, the woodworker himself may take more interest in learning the scientific methods of film operation as a result of these novel "cinemicrographs."

New Cadmium-Gallium Lamp

THE production of light sources from which pure monochromatic light of various wave-lengths and great intensity may be obtained is from a principal viewpoint of great importance in the field of optics.

During the past month, the Bureau of Standards has constructed an enclosed quartz vacuum lamp having an alloy of gallium and zinc, similar in many respects to the cadmium-gallium lamp previously designed. The design of the new lamp has been so perfected that the lamp operates quite satisfactorily with very little heating, giving several intense lines, one red and several blue and green.

Preliminary experiments have been made in connection with the production of a thin layer of light on the walls of the lamp, but have not been entirely satisfactory owing to the high temperature at which it is necessary to pass the lamp to prevent the diffusion from depositing on the walls of the light space, thus covering up the arc.

Reaching Upward With Concrete

How the Twelve-Story Limit Set on Concrete Buildings Has Been Discarded by Enterprising Architects

By Norman M. Stinemann

BY 1902 work was started on a sixteen-story reinforced concrete office building in Cincinnati, known as the Ingalls Building. This was the highest single story in reinforced concrete construction up to that time. To some it may seem strange that architects and structural engineers did not follow the precedent established by this unusual building, but continued to design tall buildings by older and less sure methods. It was much less encouraging to an architect to argue the client away from reinforced concrete than to admit that he did not know how to deal with it in the design of a large building.

By 1908 the theory of the design of reinforced concrete structures had become quite well established, but in its tentative an erroneous idea concerning the profitable height limit of reinforced concrete structures became well rooted. It was said that a height of twelve stories was about the economic limit, and that in cases of higher structures the lower-story columns would be very large and would occupy too much valuable space. Perhaps not one architect or structural engineer or writer out of a hundred at that time admitted had actually tested out its truth or falsity by independent investigations of his own. At any rate, no more Ingalls buildings appeared for many years to follow.

It was not until the mid-thirties that the prices of structural steel made the use of other materials unjustified (the fact that designers of tall buildings again turned to reinforced concrete structural frames. They soon discovered that by using an extra size of concrete for the columns in the lower stories, such as 12 x 12 or 14 x 14, and reinforcing the columns with both vertical steel bars and spiral steel hoops they could design reinforced concrete columns that were no larger and in some instances not so large, as so-called structural steel columns in the same position.

One of the most convincing results of these later investigations in the Archæological Institute, a reinforced concrete office building having seventeen stories above the sidewalk and two stories below. This structure, completed in 1917, greatly stimulated the interest of builders in the possibilities of reinforced concrete for very tall structures, so that the Arcade Building did not long hold its record as the tallest reinforced concrete building in the world.

It was superseded in 1921 by the Hyde and Leather Building in New York City, an eight-story office building having not only a reinforced concrete structural frame, but also an exterior facing of a special texture of concrete.

Not to be outdone, Dallas, Texas, came forward with a sixteen-story reinforced concrete office building known as the Medical Arts Building, completed very early in 1922. It has superseded the Hyde and Leather Building as the tallest reinforced concrete building in existence.

And now comes a story from Dayton, Ohio, to the effect that the new twenty-one-story addition to the U. S. Building in that city will contain a reinforced concrete structural frame, from which it appears that Dallas will enjoy the distinction for a limited time only. The Dayton structure, for which the contract was awarded early in 1927, will have a ground area of 70 by 120 feet for the first fifteen stories, while the upper six stories will be fifty

feet square. It will be 270 feet high from the first floor level to the top of the building. It will involve no outstanding problems of design and there seems no reason to suppose that it will mark a permanent limit to the height of buildings of this sort.

The Fact, the Cause, and the Causes of Organic Evolution

WHAT distinguishes between (1) the fact of evolution, as representing the historical series of events, (2) the course followed in evolution, for instance, whether the

land vertebrates arose from fish-like ancestors, birds from reptiles, or the like, and (3) the causes of evolution or what made and makes it happen. These three aspects, like the history of a ship, are separate though related items. They must be constantly distinguished, if there is to be any clear thinking on this matter. The historical fact of evolution seems attested by overwhelming evidence. Science has nothing to conceal, it stands "strong in the strength of demonstrable facts" and is alive just to show the evidence. The course pursued by evolution is known broadly in many instances, but in the nature of the case the evidence is limited, and many of the steps will always remain uncertain. It is, however, a calling in question of the historical fact. The causes of evolution present the most difficult problem of all and the one regarding which we know the least. The recent structures of Professor Bateson, while being exploited by anti-evolutionists, were directed wholly at our real explanations of evolutionary causation and the course of evolution. He affirmed his belief in the fact of evolution, but he said that "the faith in evolution is unshaken"—meaning by "faith," of course, a result of belief resting upon evidence.

With this distinction between fact, course and cause clearly in mind, the significance of the work in the history of biological thought can be understood. Darwin's new causation was two-fold. In the first place, he established organic evolution as the callous explanation of the past history of living things. Secondly, he offered, in natural selection, what then appeared an adequate explanation for the origin of species and hence for the causes of evolution. Darwin's evolutionary argument in his "Origin of Species" was that one species could give rise to another by means, as he believed, of natural selection or the preservation of favored races in the struggle for life. If a given species could be shown to give rise to another, the same process could be continued, to limit could be made. The type thus produced could depart indefinitely from the parent form. Once the new causation was established, the only reasonable conclusion was that evolution has taken place. The argument was supported by an

immense collection of facts along observational and experimental lines. The total result was overwhelming.

The importance of Darwin's work in the history of evolutionary thought is that it convinced science of the truth of organic evolution and proposed a plausible theory of evolutionary causation. Since Darwin's time, evolution as the historic fact has needed confirmation on every hand. It is now regarded by competent scientists as the only rational explanation of the overwhelming mass of facts. Its strength lies in the extent to which it gives meaning to so many phenomena that would be meaningless without such an hypothesis. But the case of natural selection is far different. Of recent years, this theory of the causes of evolution has suffered a decline. No further hypothesis, however, has completely displaced it.

It remains the most satisfactory explanation of the origin of adaptations. Although its sufficiency is no longer accepted. As a result of this situation, there has been much discussion among biologists regarding the adequacy of what is often referred to as the Darwinian Theory, meaning natural selection. In condemning natural selection as an explanation of the problem, biologists have often seemed to condemn evolution itself. It is not strange that the layman, for whom Darwinism has become a synonym, has believed that evolution has been rejected when he hears that belief in Darwinism is on the wane. He does not understand that what is thus meant is not the rejection of the historic fact of evolution, but the proposed cause of evolution—natural selection.—(Adapted from article by W. C. Cline of the University of Missouri, in School and Society for April 14, 1923.)

Germany Builds New Super Radio Station

AFTER the completion of the new wireless station, which the C. Lorenz Company is now constructing in the Lüneburg heath in Germany will have the most powerful and best equipped radio central in the world. At first it will be devoted to experiments on a large scale, but later it will be operated by the C. Lorenz Company, under a charter by the government, for commercial and governmental purposes.

One of the remarkable features of the new super radio station, which is located in a shallow valley between the Hergensand (172 m) and the Stein, one of the foot hills which rise above the North Sea Lake to a point of 240 m. The station is situated in the center of the valley. The antenna is placed from the top of the Stein five steel cables the structure is supported by five anchor points at the top of the Hergensand, at an average height of 200 m. The cables are supported by wind or steel, the insulated ends of the antenna are attached to a powerful electric circuit which passes a pulley at the highest point of the Stein. To the lower end of this cable a heavily insulated wire is fastened on an inclined track on the farther slope of the hill. The ballast on the car is sufficiently heavy to keep the five cables well stretched under normal conditions and to counterbalance their weight when they are exposed to strong wind or are coated with ice. In this way it is hoped that sagging of the antenna will at all times be kept within permissible limits.

For sending out electric signals waves two miles will be provided, a Poulsen-Lorentz arc-light sender of approximately 200 kw and a high-frequency generator of the Schmidt type of equal capacity. The electrical energy required will be obtained from the Walchsee Lake power station nearby. The desired high frequency will be obtained from the arc-light sender. As the equipment described will render it possible to make, for the first time, a radio transmission of the type known as sending, the result of the contemplated plans is awaited with great interest by radio experts in all parts of the world.



Ingalls Building, Cincinnati; 16 stories; completed in 1903



Arcade Building, St. Louis; 17 stories; completed in 1917



Hyde and Leather Building, New York; 18 stories; completed in 1921



Medical Arts Building, Dallas; 19 stories; completed in 1922

Waterproofing Cloth by Electrical and Chemical Action

ORIGINALLY there were two general methods of rendering fabrics resistant to water. The mechanical process of impregnating the cloth with rubber, rosin, wax or gums makes the fabric not only waterproof but airproof as well. Such fabrics are non-welding, whereas in most applications air circulation through them is essential. Chemical impregnation of the cloth with a coating which is insoluble in water, while meeting this difficulty in open to the objection that all such coatings known are insoluble only up to a certain point, and will quickly disappear on vigorous washing such as is ordinarily conducted in the household and the laundry, while such fabrics cannot be dry-cleaned, the aluminum soap which constitutes the waterproof coating, being soluble in the benzene of the dry-cleaner's soap.

Numerous efforts had been made to avoid both horns of this dilemma by the development of an electrolytic waterproofing process of some sort, but none of these processes had reached a commercial development. In 1907 this phase of the subject came to the attention of Mr. Alfred O. Tate, a Rhode Island manufacturer. Mr. Tate had been private secretary to Edison in the early eighties, at a time when the dean of inventors was working with a telephone receiver consisting of a chalk cylinder, moistened with a chemical solution and revolved by a motor. Under the variations of the incoming current the electro-acoustic properties of this cylinder in its present low variations, and it was possible to utilize those variations in reproducing the sound which had been impressed upon the current at the sending end. The device, however, was much too complicated for extensive development, and was replaced in due time, by the present receiver. It is, deservedly, the least well known of Mr. Edison's inventions but it is of interest on its own grounds. In particular, Mr. Tate's recollection of the work done with it brought him to realize that the principle involved in the waterproofing of fabrics, not merely by coating them with a water-resistant film on the surface, but by causing the water-repellent agents to penetrate into the very internal structure of the fibers themselves, was one of electro-chemistry, just as in the case of the chalk telephone receiver.

The essential features of Mr. Tate's first waterproofing machine, developed in 1906, have been retained in all the subsequent improved models. There is the graphite electrode, the cathode over which a solution of aluminum acetate is permitted to flow, an aluminum anode, and a heavy woolen pad completely enveloping the latter—a distinctive characteristic of the invention, making it possible to attain an evenly distributed waterproofing.

Laid aside for several years, the idea was picked up again after the outbreak of the war, and a second and third machine produced in 1915 and 1916. The latter was installed in Montreal in October, 1916, and used for waterproofing the fabric used in the Canadian aviation uniforms. On a military basis the machine was satisfactory, but its slow speed of operation—one yard of cloth per minute—made it plainly useless on a normal commercial basis. The controlling factor was seen to be the time of contact between cloth and electrodes, and to speed up the travel of the cloth without shortening this time of contact, the roll electrode was

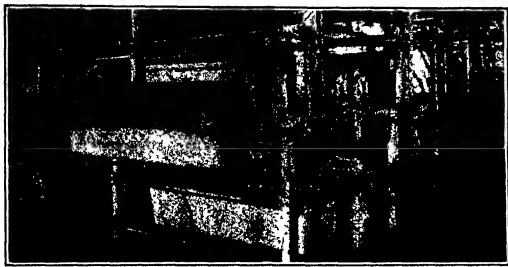
shaded for the plate. This change led to the present type of machine, in successful commercial use today at the Tate plant in Cranston, R. I. This plant has a waterproofing capacity of about 300,000,000 yards per annum.

Wool and silk fabrics are waterproofed on a machine with two sets of electrodes, cotton fabrics on one with four sets. The extra electrodes are necessitated by the structure of the cotton fiber, less easily penetrated by the chemicals than the wool or silk. The cloth passes first through a solution of caustic soda, a very dilute solution being used. The fabric dips into the

panes from the graphite cathode through the cloth to the positive aluminum electrode.

The essential feature is the simplicity and the ease with which the treatment of the cloth is effected. The cloth takes but little time to pass through the machine and it is really remarkable to observe how much its properties are changed by this short treatment. An ordinary piece of printed calico, like a sponge before treatment, sheds it like the back of a duck after treatment. Under ordinary pressure the water will absolutely not penetrate into the fibers

(Continued on page 256)



Electrolytic waterproofing and converting machine of the plate type which waterproofs fabrics of various kinds

both in an endless band, the excess solution being squeezed out as it passes between hard rubber rollers. The treatment is repeated, when the bath is ready for the electrodes. So far as the chemicals used in this and later steps are concerned, the process is identical with the electrochemical ones which it is intended to supersede, the difference lies in the more thorough penetration of the material under the electrolytic action than under ordinary chemical contact.

The electrodes are arranged vertically. The anode is built of aluminum bars, one above another and bolted together in a suitable frame, over which the woven pad mentioned above is secured. The cathode is also

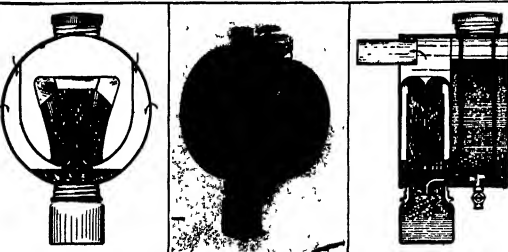
moved from the air, and the latter passes on to the engine thoroughly cleaned and somewhat humidified. Tests show cleaning efficiency over less than 10 per cent, with the engine lifting. And as the air flow is increased the cleaning efficiency always increases. Making such tests only the finest and most impalpable dust obliterated has been employed so it is claimed.

Hereafter is familiar with greater ease, the ease of the engine and its particularly "live" feel, in evening and night running. This results from the in several greater relative humidities and lower air temperatures after sundown as compared with those earlier in the day. Use of the automobile air washer results continuously in just such a condition of the air—somewhat lower temperatures and an increased relative humidity.

In the case of an engine that "pink" readily, it is a certainty that use of the air washer will eliminate the pinking and will, therefore, cause an increase in the power delivery.

To insure a clean air supply, having a considerable amount of water vapor in it, it is only necessary to have the washer supplied with water. The size and one-quarter-inch diameter (suitable for use with all engines having one inch or one and one-quarter-inch carburetors) has a water supply capacity of one gallon, which supply is sufficient for 500 to 1000 miles of driving.

The high driving efficiency of the automobile air washer is the result of the very intimate contact between the water and the air, and is due to the fact that none of the dirty water passes out of the washer with the air. The finely sprayed water is completely evaporated before it takes on the dust, and for this reason the rates of water consumption are very low and are wholly accounted for by the evaporation. As some of the accumulation of dirt in the washer has no effect upon the cleaning efficiency, nor does it cause the slightest increase in the pressure drop through the washer.



Air washer for the automobile and tractor engine, showing the method of automatically controlling the water supply to the washing chamber, and the courses followed by both air and water

vertical, and consists of graphite bars, fitted loosely into metal guides and held in position by springs, which allow a delicate regulation of the pressure against the cloth as it moves through the machine. This makes it possible to vary the pressure according to the character of the fabric being treated, and to pass a steam through the machine without requiring the apparatus. Each graphite bar is provided with a fine trough, extending the width of the bar and perforated at the bottom with small openings. The solution of aluminum acetate is fed to these troughs continually and trickles down through the perforations, wetting the cloth thoroughly and making it a conductor of the current, which

Make Believe Lightning

Investigating Lightning Voltages in the Laboratory to Solve Lightning Arrester Problems

By F. W. Peek, Jr.

General Electric High-Voltage Engineering Laboratory



Stark-cycles are caused by the flashing over of high-voltage current

IN STUDYING the effects of lightning on transmission lines and on such apparatus as transformers and lightning arresters, it is important to have the ability for producing lightning voltages in the laboratory closely approximating those occurring in practice.

An investigation of the lightning voltages induced on transmission lines has shown that during any storm, many discharges take place on wires set for lower voltages. The discharges become less and less frequent for the higher voltages, and finally very few are found that exceed about 400 K. V. or 400,000 volts. However, higher voltages do occur occasionally. Another check on the voltage is the fact that insulator strings of seven or eight units rarely flash over during lightning storms. Lightning voltages or impulses are known to be of very steep wave front, which has the effect of increasing the voltage across an insulator or other apparatus at the rate of millions of volts per second.

A few years ago a 200-K. V. or 200,000-volt impulse or lightning generator was built to give lightning voltages of predetermined characteristics. The flux link of various gaps was carefully measured and the term "impulse ratio" resulted. This generator has been added to from time to time as higher exciting voltages have become available. As its power to almost 700 K. V. or 700,000 volts was made in 1916, while within the last year an increase to approximately two million volts has been made.

It is not the intention to give details of the apparatus here since those data may be obtained from technical reports now at the disposal of the public. The voltage is obtained by charging a large condenser to the desired voltage and discharging it through a known inductance and resistance. Standard step-up transformers are used in sufficient number to obtain the desired voltage for charging the condensers. The result is a single lightning impulse of great power.

In the lightning tests described in this article the voltages were applied at a rate of 50 million million volts per second. The power may be of the order of millions of kilowatts. The time of application is measured in microseconds (millionth of a second). This type of discharge must not be confused with the high frequency obtained from an oscillator. In the lightning generator the discharge of energy is so rapid that the resultant spark is "explosive," and is accompanied with a loud sharp report or crack.

The means of the high voltages obtainable in the General Electric High-Voltage Engineering Laboratory at Pittsfield, Mass., it has been possible to learn much regarding light testing insulators. One of the problems that has been solved is whether lightning voltages will clear a shielded insulator string, just as will a 60-cycle spark-over. However, impulse voltages sufficiently high to spark over a string have not been available, but photographs made of the tests indicate that the impulse goes to the shield and clears the string. These tests are conducted in the dark, so that the camera may record the results. The photographs show

the sparks that last less than a millionth of a second. Other tests have shown how readily a lightning spark will clear the insulator string in a heavy rain. The insulator shield does not reduce the lightning arrester voltage, nor does the rain. In the case of photographs of the wet test of insulators, made at a speed greater than one-millionth second, the illuminated rain drops appear stationary in space.

Other practical investigations similar to those mentioned are being carried out in this unique laboratory. Space does not permit full details, but we may mention a few of them, such as propagation of lightning on transmission lines, protective value of lightning arresters, effect on insulators, value of ground wires, choke coils, etc. The lightning generator is also of great value in theoretical work. Indeed, one of the spectacular phases of the work has been the simulation of actual lightning striking a miniature church and houses, as shown in one of the accompanying illustrations.

The High Voltage Engineering Laboratory at Pittsfield is equipped with the apparatus necessary to carry on the problems of pure and applied research, as well as the more immediate developmental problems. The first essential of such a laboratory is plenty of space. A simple example will make this apparent. During a recent visit sixteen sparks over sixteen feet in length were obtained. A visitor's glimpse is provided so that the market may be observed in space.

It is possible to make this whole laboratory dark in a few minutes. A smaller dark room is available for tests up to 300 K. V. or 300,000 volts. The whole building is of substantial brick construction and kept at practically constant temperature inside. Apparatus is available for studying the effects of such weather conditions as heat and cold, and rain and dew formation on insulators. Special measuring instruments are also available. As an example, spheres forty inches in diameter are necessary to measure the voltage of a lightning stroke.

In conclusion, it may not be out of place to discuss



General view of the lightning-lighting producing apparatus employed in the High-Voltage Engineering Laboratory at Pittsfield, Mass.



Miniature church and outcrop struck by man-made lightning bolt

just what are the possible uses of a million volts in practical transmission. The conductor for such high voltage would be about one-half inch in diameter. If it is assumed that this is a hollow tube with copper equivalent to a steel rod, it is possible to transmit 3,000,000 kilowatts a thousand miles with about 12 per cent loss and a million volts at each end. If free-tube tubes were used there would be very little loss in fair weather, but during a rainstorm the loss would be of the order of 1000 kilowatts per mile. An approximate idea of the size of a 1,000-K. V. or 1,000,000-volt tower, compared with a 300-K. V. tower, is given in the accompanying sketch.

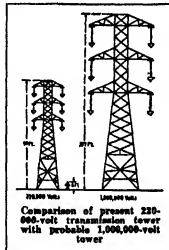
The striking fact that these figures bring out is the large amount of power necessary to make such a line economically desirable. They also emphasize the enormous size of the apparatus unless necessary. If present practice were followed, 1,000,000-kilowatt transformer units would be necessary. This would probably mean erecting them in the field. The problem of size and transportation becomes greater than the problem of voltage. However, it is only a little over ten years ago that the 220-K. V. or 220,000-volt tower in the laboratory stage as the 1,000,000-volt line dreamed today.

A New and Novel Use for Aluminum

NONE of the most interesting news items in a long time is the statement which appeared in the state press recently that in Chumata, Arizona, aluminum is being used as a substitute for wood in a most novel manner.

The statement is to the effect that aluminum sheets or plates are being used for stage scenery by the managing director of the opera house in that city. The managing director has stated that because wood is so expensive the new material has been tried and found to be successful, but this is not the only advantage. Aluminum scenery is not only lighter to handle but it is not subject to the menace of fire and it is also found that scenery can be painted on both sides of it. Besides this, the paint decorations which are put on can easily be erased and no aesthetic difficulties have yet appeared through the use of the new material. The aluminum is delivered to the theater in roughly sheeted plates of the same form and size as wooden sections of scenery and its thickness varies from five to eight millimeters.

This development emphasizes the role which it is not at all unlikely not only aluminum but light alloys may play in industrial life in the future. It is recalled that the framework of the great American dirigible "R38," which is now nearing completion in New Jersey, is made almost entirely of duralumin, a special alloy of aluminum. In the best-tested condition this alloy has a strength equal to mild steel, combined with a lightness which is a distinct asset. The Bureau of Standards has conducted some extensive tests on this material and finds that its strength efficiency, or its tensile strength divided by its weight, is 200 per cent in excess of that of mild steel. As soon as light metals and alloys are perfected in production and cheapened in cost there will undoubtedly be many other uses which they can be put as a substitute for other wood or steel uses. That such a possibility is not the preposterous dream that indicates the direction of tomorrow's work.



Radio Without Interference

Experiments Proving that Radio Messages May be Sent Successfully on Wave Length of Ten Meters

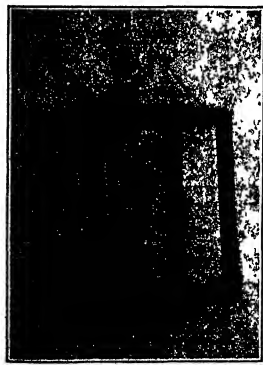
By D. H. George

DOWN at the Cleveland Park laboratories of the Department of Commerce in the 14th street of Columbia, lately if you chanced to pass that way you would have seen a most unusual contraption which looked for all the world like a queer shaped tent, made of wire lashed of course, strung in the direction, that and every other. Query of one of the several scientists who were securing to and fro from one part of the novel equipment to the other regulating amplifiers and taking records, would have elicited the information that tests of wireless communication on wave lengths of ten meters were in progress.

Had you been interested and inquired further about the novel apparatus—such as you probably had never seen before—the Federal investigators would have told you it was a parabolic reflector that was being used in the speaking-experiments that have proved the way for taking the fear out of interference—the heretofore uncomprehensible buphonia of radio communication.

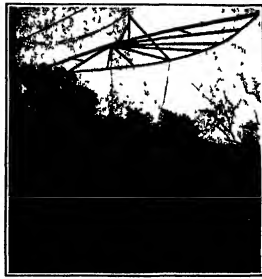
Briefly, the national search and research has developed the frequent facts that interference between different radio transmitting stations can be reduced by the use of masterly directional antennas for transmitting and receiving, and by the use of short wave lengths not at present employed. These data are of incalculable scientific importance despite the fact that they demonstrate that directional antennas are not suitable for broadcasting market reports, music or other forms of entertainment. However, the tent-like contrivance successfully for the reception of such material that is circulated by the wireless. For point to point communication—message—can be directed from a certain transmitting station to a definite receiving station—direct lineal unit can be employed advantageously at both sending and receiving ends.

It is an abrupt departure from the fundamental practices of radiography as hitherto pursued to introduce into active service a new method of procedure, previously, radio communication has been carried on chiefly by the use of wave lengths of not less than 200 meters. To violate speed limit and to attempt to harness very short wave lengths for daily service were logically the special tasks of Uncle Sam if for no other purpose than to extend the field of radio research. The use of short waves with the accompanying reduction in interference, has never been popularized despite the fact that no one is authorized than Mr. Marconi himself recommends it.



The 50-watt transmitter, consisting of a 50-watt vacuum tube, the elements of which are used as the condenser, and a simple coupling arrangement.

Albeit the national authorities down Washington was have hitherto acted on the suggestion of the inventor of a wireless the result being a series of experiments in radiography and in radiography on wave lengths of ten meters were used, at the transmitting station a reflector composed of short vertical wires arranged as elements of a parabolic cylinder. A 50-watt electron tube generating set was employed the capacity between the elements of the tube together with the grid and plate coupling, coils, focused the generating circuit. Two short, with a multiple-wire condenser—one above and one below the generating set—were used to radiate the waves from the generating set. A special coupling coil was linked between the two vertical conductors and the generating set thus was coupled to the system. The generating set with the vertical conductors was suspended in the front axis of the parabolic cylinder. Each wire of the reflector was insulated to ten meters. Its thickness, its length and its adjustment of the reflector correctly made satisfactory directional transmission was obtained. The



Forty wires, each 14 feet 5 inches long, spaced one foot apart in the parabolic reflector for maximum reflection on a ten-meter wave length.

tests demonstrated that at least 75 per cent of the radiated power was confined to an angle of 40 degrees. Reduced to brass tacks, the data showed simply that by the use of the parabolic reflector and the short wave length radio signals and messages could be sent out in a minute and definite direction with all the confounding din and confusion of atmospheric disturbances or other forms of interference. The disturbances were not only in strong waves caused in atmosphere electricity but also during the summer season the interference became so bad as to render wireless communication impossible—were practically eliminated when, such short wave lengths as ten meters were used. The small directional antennas used in conjunction with the wave lengths of ten meters markedly reduce the difficulties that ensue from Hertzian waves.

Furthermore, some of the most recent studies of point to point communication such as the sending of photographs by radio and the use of control of machines and other mechanical equipment in wireless can be carried on and improved by the directive short wave transmission. J. C. Mason, points out that wireless radiotelegraph communication offers an admirable method of communication where interference can be minimized. In addition, directive transmission makes possible exact wireless telephony, and radiotelegraph communication at large scale with a minimum amount of power as well as with the least interference. As the waves are reflected and radiated in but one direction a certain definite generating set is required to focus a certain direction than with a nondirective antenna.

A 50-watt electron tube of the coated filament type was used in the recent Federal tests and it func-



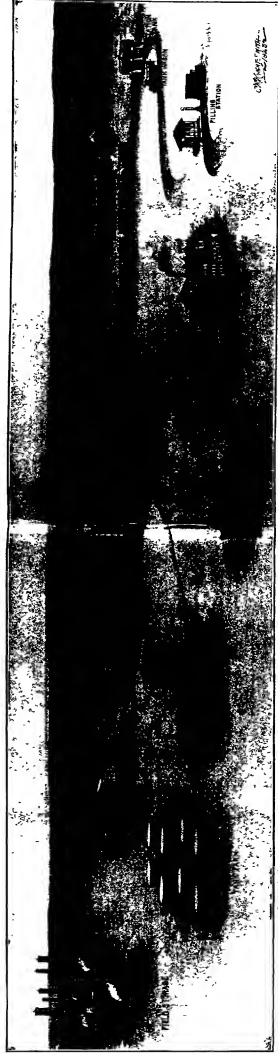
Receiving apparatus employed by Government experts in studying the directive characteristics of radiation from parabolic reflector.

tioned at higher frequencies than any of the others tried out. As the most effective method of obtaining directive transmission in the short wave lengths was by the use of a lens in the form of a parabolic cylinder this was the system followed. The wave from this variety of reflector is quite similar to a parallel beam of light which has penetrated a small slit in an opaque screen. This effect is made by suspending 0 wires from a frame constructed in the form of a parabola. Each of the wires was tuned to ten meters and spaced one foot apart. The frame was hung from a top stretched between two poles so that the reflector could rotate through 90 degrees. The suspended wires were insulated from the frame and from each other. The focal distance was made one-quarter of a wave length, 25 meters or 82 inches. The reflector was made like a parabolic cylinder because this form made the use of the plan relatively simple and obtain maximum results.

In receiving signals at distances greater than 100 feet, a receiving set with an antenna and two stages of amplification was utilized was used. An external battery was employed when receiving communications were simple. The antennas used in picking up the signals at the receiving apparatus was a single wire hung in the air, the wires were frequency and coupled at its center to the antenna of the receiving set. The antenna of the receiving set. The total length of the wire used in this antenna was 14 feet 5 inches.

As the wires were suspended one foot apart where the length of the reflecting wires was at the same. When the reflecting wires were all made the same length and the wave length of the signal waves were made slightly shorter than ten meters, the reflecting wires were thrown out of tune and the radiation through the rear of the reflector was equal to one-half that along the true line of reflection. The best possible reflection was obtained when the length of each of the 40 reflecting wires was less than 14 feet 5 inches and these wires were spaced 14 inches apart. All these data were obtained with the reflector having an aperture equal to the wave length. The aperture was then increased to 15 was because the parabolic frame being extended with ten meters, wires suspended one foot apart on each end. This arrangement resulted in no leakage at the rear of the reflector. Very poor reflection accompanied by considerable leakage obtained when every other wire was removed and the total diameter reduced from 40 to 20. This resulted because the remaining wires were disturbed by the removal of their neighbors.

In detecting the effect of leakage, the wire hole in the parabolic frame was covered by a wire. When removed, the consequence was that leakage occurred. These tests showed that for the most directive transmission the reflecting wires must be reflected must be placed exactly at the same. The reflecting wires must be tuned to resonance with the source while the width of the reflecting wires must be the same. The size of the aperture required. Strong signals were received at a distance of two miles using a single-turn coil antenna six inches in diameter.

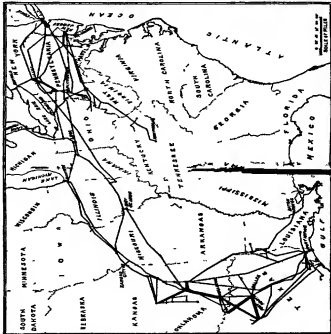


IN 1922 the United States produced over 25 billion gallons of crude oil. At 42 per cent of the world's supply. The latest discovery shows how it is piped to the refineries and distributed to gas plants, shipping, factories, railroads and the numerous other utilities.

The Story of Oil

How 23 Billion Gallons of Crude Oil Annually are Piped, Refined and Distributed to the Consumer

and are piped made easier in utility, to permit the use of the same pipe for the same purpose. The use of the same pipe for the same purpose is a common practice in the oil industry. The use of the same pipe for the same purpose is a common practice in the oil industry. The use of the same pipe for the same purpose is a common practice in the oil industry.



Map showing the 42,000 miles of pipe lines, mostly in the Gulf, which the crude oil is distributed throughout the United States.

EVEN IN THE best of times, the oil industry is a most interesting one. It is a story of the struggle for power, of the struggle for power, of the struggle for power. It is a story of the struggle for power, of the struggle for power, of the struggle for power.

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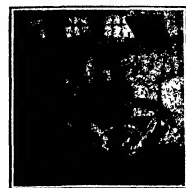
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Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News



The device that enables the driver to protect himself from glare

Bright Lights—But No Glare

ALTHOUGH everyone who has sought to solve the glaring automobile headlight problem has gone at it from the standpoint of dimming or diffusing the rays of the headlights by means of special lenses, shades or other similar apparatus, failing to recognize that it is practically impossible to subdue the rays of the oncoming lights to the extent that they have no glare without sacrificing some of the road illumination for which they are put on the car. A solution of the problem from the logical standpoint would be to make the driver immune to the bright rays of the oncoming car, thus enabling the other fellow to have the needed road illumination without in any way affecting the driving vision of the man whose car is properly equipped.

A well-conceived attempt to do this consists of a small black-enamel plate of sheet metal attached to a hatched device to enable it being adjusted to any desired angle. It is arranged to fit the top of the windshield by a universal holder (a special fitting is provided for enclosed cars), and the right edge is

set on a line with the center of the steering wheel. In the daytime the metal shield is swung up out of the way, being held firmly in its position by the ratchet mechanism. In use, the shield is swung down at such an angle that the driver can look out under its lower edge and see several hundred feet ahead to enable unimpeded driving vision while at the same time the dazzling rays of the other fellow's lights are excluded by the metal plate. A few minutes experimenting will show the driver just what is the right setting for his car and his height, and once properly adjusted it need never be disturbed.

What Is Glare?

THE phenomenon of lighting on glasses that has been excruciating the nature of glare recognizes, in its respect, several distinct varieties. "Veiling glare" is produced by light sources that uniformly superimposed on the retinal image, thus



When the elevator is idle there is no obstruction to the sidewalk

reducing contrast and visibility, and corresponding to the fogging of a photographic plate. "Dazzle glare" is produced by advertisement light as refracted and scattered so not to form part of the retinal image. "Scotopic glare" is produced by light of intensity such as to fatigue the retinal sensitivity below the convenient limit for small images, and corresponds to overexposure in photographic plates. The influence of these three forms of glare is analyzed and some experiments made to determine the minimum of the glare dose limit. A target on which the black letters in various positions were distributed, was illuminated by a extended source. For the purpose of producing glare incandescent lamps were mounted behind a semi-circular aperture in the target and for producing extreme dazzle glare an automobile headlight was exposed. The resulting glare was measured by superimposing a lens on slide so as to cover the field of view and tilted so that an image of an illuminated surface was seen by reflection. The target was thus seen through a luminous haze. Quantitative data, illustrating the reduction of visual acuity are presented. It is concluded that dazzle glare is of the most serious consequence, and some suggestions for further experiments made.

One-Man Roof Workers

THE Seattle Daily Times has installed on the top of its six-story newspaper building a small "one man" railway for the convenience of workers on the roof. A little car loaded on the roof carries a 200-pound workman, with a crowbar, a hammer, and a platform suspended from the car, can reach all cornice lights on the building.

Double-Lever Steering for the Wheel in a Car

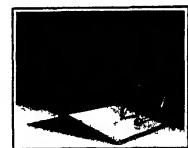
WHAT the driver of the small car with the direct lever steering, can achieve more effectively with a more effective steering gear, needs more than anything else is additional steering leverage to control his car in an emergency, to prevent the wheels from being out of his hands or the locking of the front wheels in front of the car. The principle of compound leverage is utilized to give him this increased power in the steering wheel. The full run parallel to the ball and socket joint and one lever as when it comes from the factors, the car thus equipped steers through two levers and two ball joints.

In illustration the single lever comes off the bottom of the steering post and is replaced by the compound lever *I*, which actuates the steering arm *B* through the full run parallel to the ball and socket joint *C*. There are no gears and no springs.

An Accident-Proof Sidewalk Elevator

AMAN, the business of modern city construction that offer great danger to life and limb when not properly safeguarded is the elevator shaft rising at the side of a sidewalk. Practically every large building disposal of the shaft by this bringing them to the surface, and more than one pedestrian has been killed or injured in accidents involving a so-called sidewalk disappear beneath his foot or fit up into his face to make a proper fit for the elevator to rise out of.

The provision of gates and warning signs is not sufficient as he simply provides for the number of persons killed or maimed by the unprotected shaft crossings. What is



As the lift rises the doors open and the gates swing out, provided there is no obstruction

needed is something that absolutely prevents the elevator from rising when there is any reason why it should not rise. We illustrate the installation designed by the New York concern which does this.

With the elevator is inactive the gates fold back against the wall as shown in the first view. When the control is thrown over to start the elevator upward a stationary link is bent for some little time before the shut doors in the sidewalk break at their central point of junction. With this breaking, the gates swing out. The lost proof lifts that somebody might be hurt is removed by the fact that any weight on the rising doors, or even so light an obstruction as a hand placed upon the swaying gates will hold the elevator motionless until it is removed. The whole



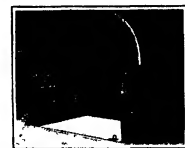
Compound-lever steering for the car that lacks a worm

apparatus is so interlocked so tightly that it is impossible to feed the wheels or sliders in New York who are interested in such this elevator in operation will find a type of installation at the Park National Bank on Fulton Street, just off Broadway.

Short-Wave Oscillator at Low Pressures

Experiments with Irish tubes giving wave oscillations of the order of a meter. Hurkman and Herz found a type of oscillation apparently due to the motion of electrons in the tube. Induction of the external magnetic field of the vacuum tubes and induction of the external magnetic field of the vacuum tubes and induction of the external magnetic field of the vacuum tubes and induction of the external magnetic field of the vacuum tubes.

The National Bureau of Standards has been working on the problem of the short-wave oscillator at low pressures. The results of the experiments are being published in the *Proceedings of the National Academy of Sciences*. The experiments were conducted by J. H. Hurkman and J. H. Herz, and the results are being published in the *Proceedings of the National Academy of Sciences*.



When the elevator reaches its limit of travel the above appearance is seen

The latest convenience for the roof who works at the edge of the roof



Another article for the home beauty factory—a marcel waver

men were admitted, and the occurrence of a negatively plate current demonstrated both oscillations and negative plate current caused at very low pressures. The pressure of the residual gas was measured by the resultant ionization.

A Versatile Woodworking Machine

A MACHINE, operated by electricity, which will do almost any sort of work done in the woodworking industry is a recent development of a Cincinnati manufacturer. The machine is mounted on four wheels and a three-

point suspension that allows a very quick change to be made from one tool to another, on a matter of feet. It is claimed that the change is made as rapidly as if one had to look for the desired tool in a chest.

After the tool is made up it is tilted and is suspended over the work and in use is pulled down to the work and a perfect balance taking place makes it possible to relieve the work of any unnecessary weight.

It is claimed that a compound motor such as the top of a ship rafter is made as easily as a square cut and all opera-

blatives can be left in the cylinder with, to continue cutting after the engine is assembled and in operation. The hone fits itself without adjustment to any cylinder from 2 1/2 to 8 inches in diameter. For larger cylinders, extension blocks may be set into each wing of the hone, and it acts automatically as before. The hone is designed to be driven at speeds of 800-1100 revolutions per minute, by a variable electric drill, standard drill press, or other rotary machine.

Beauty Via the Marcel Way

AS the creation of beauty is a part of the pursuit of happiness the lady with strictest looks considers the regulation of curls one of the legitimate attributes of life. As a means to this end there is manufactured now an electric marcel waver for individual home use at a price practically the same as the better makes of electric curling irons. Little risk the lass with the bobbed tresses and the android with white hair have had to depend upon visits to a beauty parlor to obtain the coveted marcel wave. As the waver has two heating elements, between which the strands of hair are placed, the heat is evenly applied, and our picture shows how three waves are made at one operation.



Longitudinal and lateral springs on the same car

A Novel Spring Assembly

DISMITS the unsuitability of automobile manufacturers—withholding for the moment the admission that the tin lisle is an automobile—for the longitudinal spring, the lateral type that characterizes the genus Dyer has its advantages. Some such thought as this must have been in the mind of the California inventor who designed the evolution we illustrate herewith in which an attempt has been very cleverly made to imitate both types of spring upon a single car. Across the subject the ends of the conventional longitudinal springs a heavy bar usually has been



Grinding

Another boring

Planing

Mitering or beveling

The all-around woodworking machine, shown in a few of the many uses to which it may be put

point suspension so that it can run on a truck on a carpenter's bench. Its position on the bench is such that the flexible drive hangs over the work side of the bench. A 1/2 horsepower motor develops sufficient power to work two-inch stock and under. The tools are mounted on sundries individually, which are inserted into a hollow spindle to which the driven pulley is secured. This type

tools are done while the timber lies on the bench. A stair horse can be cut, it is claimed as quickly as a man can lay it out, with a square and pencil, and the steps are cut square while the risers are cut either square or mitred. Where mortise boxes are to be made the doors are skewed up near a work bench and twenty mortises, counterbore for the fore of the box may be done in an hour.

The motor supplied with the machine will do all the simple moldering, bending, tenoning, grooving and splitting. To take the place of an ordinary brace and bit a boring mandrel is supplied. For screw driving work a bit with a counter-sink right on it is used and this makes the hole and the counterbore at the same time.

An Automatic Cylinder Hone

DEPENDING upon centrifugal force to expand it to proper size and to force the individual stones into contact with the cylinder walls, the new hone recently put out for automobile use by a Chicago firm is self-adjusting, self-centering and self-aligning. In this way is insured equal pressure on all stones with the elimination of springs and the prevention of unequal pressure upon the stones. The stones polish the metal surfaces without the use of any liquids or lapping compounds and without filling. This is a great advantage. In that no

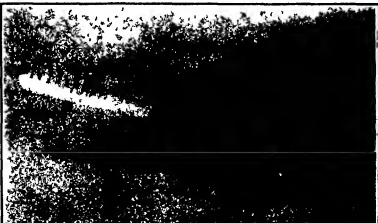
The Folding Toothbrush

DETERMINES a priori today that one might wish, forming is to carry a toothbrush if you are away from home for the entire day. This brush has been specially designed for this purpose. The brush separates from the container and goes into it when not in use. The case is metal, ventilated for drying, and is of such a length that it will fit many places—among them the vest pocket.

placed, and below this, attached at both ends and in the middle hangs a very flat spring, cross-wise of the car. The front axle is supported, not on one of these and through that one upon the other, but actually in part on both. The result is claimed to be extraordinary success in actually taking up, in the springs, without transmission to the body and without the use of shock absorbers, all the jolts of heavy going.



Sectional and longitudinal views of the cylinder hone that automatically adjusts itself to the size and center of cylinder



The toothbrush that folds up and goes in the pocket



Handy carrier that reduces milk-bottle casualties

No More Spilled Milk

IT is the fate of children as well as grown-ups some time to cry over "spilled milk." The fourth milk bottle when held with other kitchen supplies will slip from the hands or arms of the carrier. A little carrier shown here is said to prevent such catastrophes and hold the bottle safe. It provides a wooden handle, when held as shown, which locks the two wire supports securely under the rim of the bottle top.

Daylight Reflections in Show Windows

POLISHED plate glass forms an excellent mirror, and reflections of brightly illuminated objects in streets are apt to be formed on the glass of show windows, interfering with the effectiveness of the display. Attempts have been made to overcome this by using curved glass, but the lower edge of the glass is then inclined $1\frac{1}{2}$ to 2 feet behind the front line of the window, and such special glass has other drawbacks. Recent patent reflects that may now be eliminated by the use of sufficiently high artificial illumination within the window. Objects in bright sunlight may be illuminated to 1000 foot-candles and the images of them on the plate glass may appear about as brightly as bright as the objects themselves. Hence an artificial illumination of 1000-2000 foot-candles is needed to render such images imperceptible.

In transactions of the American Illuminating Engineers Society for December, 1922, Harrison and Spaulding



Combination laundry unit that includes a hot-water boiler

describe the use of six floodlights, yielding 25,000 aggregate foot-candles to overcome such efforts. The lighting units were mounted in recesses in the ceiling, the light being transmitted through the glass being transmitted through the glass, and the shade at which the reflectors were tilted could be adjusted within wide limits so as to get any desired effect. The frames containing the diffusing glass were hinged so as to afford provision for cleaning the glass. The shades overcoming the difficulty of troublesome reflections, this special method of lighting yielded to the attractiveness of the window. Tests showed that when the artificial lighting was on the number of people who stopped in look at the display was twice as great as when the window was unilluminated.

Light-Weight Radio Set

THIS little radio set held in the palm of the hand can also be carried in the pocket. Its manufacture is cheap for it that it is sturdy and dependable and not in the least a toy. Its tuning in facilities enable the user to cut out all interference.

All that is necessary for enjoying radio concerts while hiking, motoring or camping is a hand set and a few feet of wire to hook up to a wire fence and ground.

Screws On But Never Off

THIS is an unusual arrangement for a lock. The radiator cap in place is in twisting. A handing inside the cap contains a lever for screwing on the radiator plug. This twisting is arranged with a ratchet so that it will screw on but never off or cause it to remove it.

In addition to this feature it eliminates the trouble of the usually necessary to remove the regular radiator cap.



Their proof radiator cap that springs back to admit water

for filling the radiator with water. To fill the cap and thermometer turn back with a spring arrangement. In moving the hand spring it forward over the opening.

The Cottage Laundry

FOR the student of short or small cottages that is not provided with laundry tubs, this combination of tubs, tank, heater and boiler in one will be found convenient.

Many small articles that must be laundered frequently can be cleaned on this tub board. It is used as shown.

Static

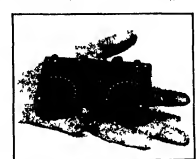
SIX papers in *Revue de l'électricité*, issues of July, 1922, to February, 1923, deal very thoroughly with the various possible sources of atmospherics or "parasites" encountered in every day practice of wireless telegraphy, and discuss in very great detail the numerous methods which have been employed by the authors and others to eliminate the trouble. In the first paper the authors classify atmospherics as follows:

(a) Atmospherics due to storms (accompanied by lightning flashes), (b)

local atmospheric—due to voltage fluctuations in the atmosphere layers near the receiving aerial, (c) cosmic sources—originating outside the ionosphere of our planet, possibly having solar sources, (d) miscellaneous—presence of a local temperature of the air, atmospheric pressure, etc.

Consideration is given in diurnal and seasonal variations of intensity of the parasite waves. The form of the atmospheric wave-length, etc. are also discussed. With regard to the elimination of "atmospheric" nuisance currents are described in detail. The more important of these are classified in the authors as follows:

(a) continuous of high frequency (radio)—cosmic in origin, (b) as the case happens, detectors in opposition (found a double crystal or double-circuit method in which one detector is an active, the other less sensitive and in opposition), (c) saturated systems (Marconi system—limiting, the



This month's radio digest

unknown magnitude of the "stray" in adjustment of the system near with relation current. (d) miscellaneous—Marconi is noted in which a model point for a certain number of frequencies in the antenna circuit is connected to earth. The "stray" of different wave-lengths is conducted direct to earth while the fundamental are transmitted through the receiving circuit in the usual manner. Systems involved in detection, fading inactivity in distance with units, and others are described in considerable detail.

For the comparison of theories of various systems in eliminating parasites the authors have devised a mass of data during the results of intensity of the waves and the normal signals. A method depending on a new principle is described and various modifications of the method are described in detail. It depends to principle on the observation that "atmospherics" are usually propagated in a direction normal to the surface of the earth.

Centralization of German Long-Distance Radio

IN order to facilitate wireless traffic a receiving station has been installed a few miles from 40 kilometers in a southerly direction from Nauen. A similar arrangement has been adopted at Hildesheim, the receiving station for which is now at Hagen. It is intended to use the same stations for communicating with a distant station from Berlin using Nauen for transmission and Hildesheim for reception, had flow connecting each of the latter with Berlin and for communication with New York, using the station at Hildesheim for transmission and that at Hildesheim for reception.

No Dust Escapes

VACUUM cleaners have come into use in the home, but there is still much dust for the dustpan.

Now comes this improved pan because of the wire arrangement shown at the back of the dust attractor. When the foot is applied to the wire the foot



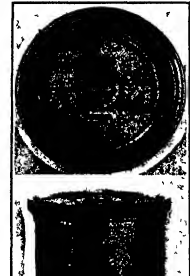
The dustless vacuum cleaner

of the pan keeps the floor, permitting to dust or dirt to sweep into the dustpan. The short handled dustpan should be no more. This form, handled one takes the sweep out of sweeping, and when raised carries the pan in a vertical position shutting the dust inside where escape is impossible.

A Better Barometer

ANIMATED barometers in use since the nineteenth century have not been constructed on the same lines. They are rather intricate and owing to friction and viscosity, requiring they even record an increase in pressure when a decrease has occurred, or vice versa. This is due to the fact that the difference in air pressure and hence in height when moved from the tank top to the top of a book lying on the table.

As little as the low instrument is expected to be of fundamental importance to the sailor. In rapid descent instruments of the old type were often 25 or 30 meters in error with the actual height. In more than one meter off. The instrument is not confined in aviation however. It can be applied to a large number of other purposes, such as ground surveying, mine and aerial observations, etc. A spe-



Two views of the newest and most accurate barometer



Lubricating an automobile chassis by means of the high pressure system

(1) Light type is offered for such uses as these. Also in naval and mercantile marine uses the Paulin system will give a far more accurate weight of grease than its predecessor.

High-Pressure Lubrication for the Automobile

FOR a true appreciation of an automobile chassis lubricant it is necessary for one to handle the old-fashioned and new grease cups. These cups are filled with grease and screwed down on to the bearing down to the bearing surface. As often as not the cups not being sufficiently filled, failed utterly to perform their function with the result that rapid wear soon asserts itself in high repair bills.

It has revolutionized for an ingenious American to develop a simple system of high pressure lubrication for the automobile. In this system which is now standard on our leading makes of automobiles, use is made of a patented ball grease valve fittings in place of the meaty grease cups and in means of a hand compressor the lubricant is forced into the bearings under a pressure of 500 pounds to the square inch. This method has a double advantage for while it is forcing the fresh lubricant in it is forcing the old grease out. Thus it ensures clean bearings at all times and works frequently enough the makers deliver complete lubrication of the chassis every 500 miles.

The high pressure lubrication system can be had with either a flexible hose



Gas mask intended for the use of tank crews when passing through tunnels

which makes it easy to reach the inaccessible lubrication points or with a new spiral valve compressor in which the compressor is built up having the fitting and it is automatically released when the connection is made. With the spiral valve compressor either oil or solidified lubricant can be used, under a pressure of 2000 pounds per square inch.

One of the greatest difficulties to overcome in lubricating automobile chassis is cleaned bearings. Sometimes especially in tight fittings the grease hardens and cokes and which fresh lubricant is applied even under forced pressure the resistance is so great that the old grease cannot be displaced. If this condition is not remedied the dirt and grit in the bearing goes on chipping and grinding away until the bearing is ruined. To solve this problem a pump has been invented which is capable of developing a pressure up to 8000 pounds per square inch which is sufficient force to clean out any bearing no matter how badly clogged. It is a simple piece of mechanism and the price is relatively small bringing it within the reach of average auto and truck equipment.

Another feature of this lubrication system is an all metal lubricating spring or meter made up of coiled spring steel which serves the purpose of a pump which when it is necessary to pump and keep out dust and water while maintaining a constant pressure of the lubricant is forced in between the leaves of the spring.

The many advantages of this high-



The dark spot in the beam of an automobile headlight, as shown here, is caused by the bulb's being out of focus

pressure lubricating system have made it a standard feature of 8000 motor cars now in use. Besides it is finding many industrial applications, where portable lubrication at frequent intervals will save minimum of labor is a prerequisite.

A Tunnel Mask for Locomotive Crews

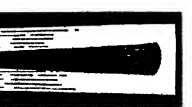
THE mask shown in the accompanying illustration has been designed for use by engineers and other trainmen for protection against gases usually encountered in tunnels and also as a protection against intense heat and escaping steam or from flying glass caused by the breakage of the water glass. Indeed, the mask is expected to protect its wearer under any and all conditions.

The primary object of the mask is to provide a head protecting mask which will supply fresh air to the wearer from a suitable source, such as from a compressed air valve of the locomotive, the air passing from the interior of the mask through a heat insulating chamber formed by a double wall, so that a current of fresh air is continually supplied to the mask and will prevent the heat from passing through the walls. The mask also provides means at the point of entrance of the air into the insulating chamber to muffle the sound incident to the entrance, so that the hearing of the wearer will not be interfered with. Further the mask provides protection for the ears against the sound of the engine exhaust within the tunnel, and the sudden atmospheric change due to the engine's leaving the tunnel.

Headlight Focusing Problems

ONE who observed carefully the automobile that he meets at night will reach the conclusion that the largest part of the glare problem would be solved if every driver were compelled to focus his lamp properly. It is hardly an exaggeration to say that in a majority of cases the headlights are improperly focused, causing light to fall where it should not and creating shadows where there should be light.

The parabolic reflector in universal use on head lamps has what is known as a focal point and possesses the property that rays of light originating at this point, and reflected from any point whatever of the mirror, will all be sent out in a series of parallel lines. But to take advantage of this property we must have the filament of the lamp at the focal point of the mirror. If the lamp is moved too far forward, the rays are reflected convergently, so that those from the lower half of the reflector take an upward course and those from the upper half pass slightly downward. The rays converge here inside or outside the hollow of the reflector and the resulting illumination is open to two objections. Only one half of the light falls upon the road which is therefore lit only half as well as it might and should be, and the other half passes outward and upward as an unnecessary and illegal glare, and results in danger from the eye of an approaching driver meets the diagonal along, which the rays are progressing. The same is true in the world will eliminate these defects unless the lamp



is first properly focused. If the lamp is behind the focal point the ultimate result is the same though different attended. Here the rays are reflected divergently, so that those from the bottom converge near the road and those from the top half pass out into space.

In either case the reflector is not a parabola—sometimes through manufacturing errors and sometimes through wear and tear of the paraboloid. Again, we have lamps where the travel of the bulb, forward and back is insufficient to permit proper focusing. Moreover, if one will inspect a dome or an oval, one will find that the filaments occupy different positions with reference to the base, some being larger than others. This necessitates a focus focusing with each new bulb that is mounted, and focusing is not without its difficulties. Moreover, it will be found easy to detect the shadow cast by the glass point of the bulb, if this comes in a direct horizontal line with the filament. If the bulb is properly focused, this shadow will not be at all apparent—it will not be back, but far beyond the point itself. But if the lamp is out of focus, so that the rays do not pass in parallel straight ahead of the bulb point, then that of everything else, will be cast in effect, as shown in the drawing.

Most automobile manufacturers give instructions for the proper focusing of headlights, and if these are followed by the motorist in general, the harmful glare would be well worth the little cost and attention required.



This machine prepares and dispenses a cup of hot chocolate in the drop of a coin

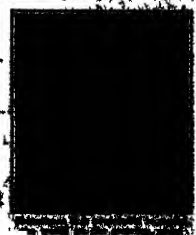
An Automatic Dispenser of Chocolates

FROM Italy comes the accompanying illustration of an automatic machine for dispensing hot chocolate. Instead of having the chocolate all prepared, ready to be served this machine prepares the chocolate from powdered form to the addition of the requisite water or milk and the proper heat, in the space of twelve seconds.

The machine is operated by a small electric motor of one-twelfth horsepower, which performs its work upon the introduction of a coin or a special metal check in the slot. A glass reservoir on top of the machine supplies the milk or water at the same time as the chocolate reservoir holds the cocoa in powdered form mixed with the required proportion of sugar. Upon the introduction of the required coin or metal check, the correct amount of milk is heated by a steam jet, and the cocoa and sugar powder is introduced and stirred, after which the hot chocolate is delivered into a cup. We have had hot chocolate dispensing machines but none that concocted the drink before serving it.

Finding the Watch on the Steering Wheel

AMONG the latest automobile appliances is a device for holding a watch on the steering wheel of the car. It consists of a simple covered wire arrangement that clamps to the rim of the wheel and holds the watch in such a position that the time may be readily read. It is not always advisable to install a timepiece on the dash of a car, as it necessitates cutting a hole in the wood or metal dashboard, opens a dirt corner as regular equipment on the car.



The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGE, M. E. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles.



Combination waterbar and flusher for street-cleaning.

Two Jobs from One Watering Truck

STREET-CLEANING and street maintenance operations give great scope to the motor-truck manufacturer for the design of valuable combination outfits mounted on more or less conventional chassis, and embodying the apparatus for all sorts of public service jobs. Among such designs an interesting item is the combination waterbar and flusher illustrated. Flushing has ordinarily been a job for a man with a hose but when done so, it results in great waste both of labor and of water. The big tank illustrated will operate when sprinkling is in order and when flushing is to be done it will flush—as the action picture shows.

A Motorbus Chair Car

AN innovation in suburban transportation has been inaugurated by Yonkers, Salem and West Putnam Ohio, by the installation of four motorbus chair cars, these equipped to perform care of high-class railroad trains. The chair car is a new type mounted on a modified truck or special bus chassis, especially designed for passenger service. The coaches are entirely of steel and finished after the regular Pullman car individual chairs with luxurious appointments feature this latest advance in motorbus design. They are of wider, of generous dimensions and are fitted with removable seat and back cushions, making room for cleaning an easy matter. Schedule of service from Yonkers to Salem begins at 5 o'clock daily and runs here Yonkers every two hours until 7 o'clock at night, while the first East Putnam car leaves daily at 8 o'clock and every two hours thereafter until 5 o'clock at night. The motorbus chair

car service has aroused here interest among transportation men as it can be used for churning trips and for every sort of social use as well as in more utilitarian fields.

One-Man Road Grader

THE grader illustrated is an attach ment so constructed as to utilize the weight of a popular small tractor as well as the power delivered by it in the operation of the grader. The attachments are designed so the installation can be easily made. The frame is of standard six-inch section steel channel and all castings are of electric furnace steel carefully heat treated. It is possible to apply a ton weight on the blade of the grader where it is necessary (to cut hard spots in the road surface) without taking the weight from the tractor's wheels. When the grader is making a heavy hard cut it is impossible to slide the rear of the grader sideways due to the distribution of the weight on the rear wheels.

The grader blade can be tilted and angled to any desired position by the operator from the grader platform. In the method of applying the one-man grader to the small tractor it puts 2500 pounds of weight on the tractor axle which is the same weight as the axle originally carried under the tractor, therefore the whole weight of the tractor is thrown to the rear wheels. With a loaded rubber wheel equipment the unit weighs 3½ tons giving a wonderful added drawbar pull to the tractor. The one-man grader frame is heavily constructed of steel throughout using heavy steel castings where castings are required. The grader as well as the tractor is carried on roller bearings having in addition the best possible method of lubrication.

When equipped with rubber wheels this combination mounted on roller bearing chassis makes a most ideal equipment for road maintenance work as it will make a speed of eight to ten miles per hour on highways where that speed is required for traveling from place to place and a working speed from one to ten miles per hour at the will of the operator. Any speed chosen by the operator is maintained by the motor speed governor. The 15½ foot wheel base of the machine gives it real a wonderful leveling effect on the road as the blade



The one-man road grader.

is carried between this long wheel base. When a wheel of the motor is left in the gear the operator has only the gear shift and clutch to operate. Both of which are conveniently handled from the platform and these controls can be handled as easily as the operator of the tractor. After the grader is in position the entire attention of the operator is as he is concentrated up to the grading work as the tractor automatically cares for itself therefore one operator can handle the machine with ease. No skilled operator is required to handle it, because but the claim is made that any one can handle it perfectly in ten or fifteen hours time after limited instruction.

The grader moldboard is equipped with a reversible cutting edge so that it can cut in either direction. The cutting edges are realized from each blade. The cutting edge used is finished for the grader are special high carbon heat treated steel to warrant the longest life possible. If this is a real work. When the grader is used for the maintenance of hard gravel or asphalt road or for city or municipal work rubber wheels are used which give the unit the speed required for traveling from place to place and simple travel for that class of work. When the grader is used in heavy road grading, as in construction of new roads or subdivisions, standard wheels may be used or for greater traction a rigid rail truck is used.

A heavy snow removal use of this grader gives greater efficiency at less cost than any other equipment ever produced. This single-unit tractor grader perfectly adapts itself to contractor work as in doing finished grading the 15½ ft wheel base gives a wonderful full leveling effect and as the blade is rigidly carried between the four wheels the grade can be kept uniform to a fraction of an inch. In working between the 5 runs the grader keeps the road leveled when cut up by trucks and will cut down hard high spots in the grade thus saving many men as it is handled as readily in backing up as in going ahead.

This grader is found to work well in muddy conditions as the blade removes the sticky top surface ahead of the driving wheels thereby always giving the traction wheels a finished muddy surface to run on. In making a clean cut out ditches two wheels of the unit are put into the ditch with the blade at any angle desired and the dirt is thrown up into the road. Hard clay

roads can be graded when dry as well as wet as the tractor has plenty of power and is able to cut the hard uneven clay road surface.

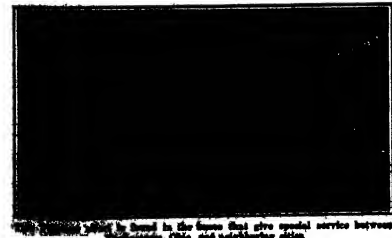
Handling Eggs in Bulk with Minimum Breakage

EARLY dry bird reports of new uses for motor trucks but the latest and most interesting as well as most work in which a motor truck is used comes from a little Denmark where Axel Brogaard an egg buyer is using a motor truck to haul eggs in bulk. In this country a certain percentage of breakage of eggs is expected even with the use of special crates and every safeguard is taken to protect the fragile freight but in Denmark many buyers handle the eggs in bulk.

He has a 3000-lb. truck which he loads with 2000 eggs that weigh approximately 27½ lbs. and Mr. Brogaard runs up about 400 farms weekly being able to fill his truck. The truck body is the regular express type with high flare boards added. Between the first and second layers of about 1,000 eggs each Mr. Brogaard places a layer of straw three quarters of an inch thick. After that protection is placed between the eggs. At the top of the truck was carrying 22,000 eggs valued at around \$3000 which is an average daily load. It is said that the loss of eggs carried in this manner is no greater than if they were packed in the regular egg cases used in this country. After he has taken on about a half a load Mr. Brogaard says that he is able to run his truck at full speed on solid time.



Special attachment for converting the tractor to grade work.



Special attachment is found in the frame that give speed service between the motor truck, city, and neighboring cities.

The Heavens in October, 1923

Another Contribution from Atomic Physics to the Study of the Stars

By Prof. Henry Norris Russell, Ph. D.

ANY TIME, during the last few years, have we had so much to report in these columns of the rapid advances in the interpretation of stellar conditions that follow the work of the physicist. The rate at which our knowledge increases shows no signs of slackening.

We have already told of the new understanding which has come of the origin of the spectral lines—the electrons, circling in complex orbits about the central nucleus of an atom, have not one but many different sets of possible orbits, and how, when a change from one of these states to another happens, the energy set free is radiated (or, perhaps, just required to effect the change is absorbed) in the form of light of a perfectly definite rate of vibration, giving a sharp line in the spectrum.

For some elements, such as sodium and potassium, the possible orbits are relatively simple. There are but a few dozens of lines in the spectrum and the relations of those have been satisfactorily worked out. For others, however, and notably for iron and some similar metals, the spectrum shows thousands of lines, and conditions must be very complex. These cases defied analysis till a year or two ago, when a Spanish physicist, Dr. Catala, working in the laboratory of Professor Fowler at London, succeeded in interpreting the spectrum of manganese.

Whereas in a simple case like sodium the various orbits occur singly, or in pairs very nearly alike, in manganese they come in groups of three, four or even seven. The transition between one state of giving rise to double lines, then to triple groups of nine, twelve or even fifteen lines, arises, however, but complicated way. Once the rules governing such "multiplets" or groups of lines had been found, the way was cleared for further advance. The intricate spectra of chromium and molybdenum yielded to investigation—totally at the hands of Dr. Kros of the Bureau of Standards, and the latest news is that Dr. Walters, also of the Bureau, had succeeded in the attack upon iron, which seemed to be the most impenetrable fortress of complexity. There is no doubt now that we are within sight of the general solution of the problem of the spectral lines, and that within a very few years we shall have at our disposal a knowledge of the physical changes which in the atom which may give rise to the production of any given line in the spectrum.

Really striking has been the progress in the study of the spectra of stars, which are given out by atoms from which one electron has already been removed. Several electron on the star are shifted from one orbit to another, giving rise to a new and entirely different set of lines, and after this has been taken clean away, a third and fourth may successively follow, giving two new spectra. Theoretically this process can be continued until all the electrons are stripped from the atomic nucleus, but usually, after three or four are gone, the radiations resulting from further changes are of such short wave length that they resemble X-rays rather than ordinary light. The electrons that are loosely enough attached to give rise to the relatively slow visual waves are usually the same as those that operate in ordinary chemical combination, so that the number of different spectra normally observed is small (the one which defines the "valency" of the chemical—though violent excitation often brings out one additional stage. Thus magnesium has two visible spectra, aluminum three, and silicon four. Many spectra, depending on the removal of the second electron from an atom are known—the first case being that of iron, studied by Fowler. Recently Paschen, in Germany, has worked out the spectra given by aluminum which is losing its second or third electron (the first case has been worked out), and Fowler in London has identified all four stages in silicon, though only the last has been published in detail.

What It All Means to the Astronomer

The various stages of ionization are so extensive that it takes a good deal of work to become master of it, but this labor will be necessary for the student of the stars, and will repay the effort. The reason for this is not far to seek. The atmospheres of the stars—in which the absorption lines that fill their spectra are produced—are composed of hot, rarefied gas, so hotly agitated to combine with one another—indeed, in the hottest stars almost all of them have one electron knocked off, and many two or three. The higher the temperature and the lower the pressure, the larger will be the proportion of atoms in this disintegrated state. We do not have to guess at it, the difficult but powerful investigations of thermodynamics lead to formulae which should serve as a trustworthy basis for our calculations, which were first made by Balmer of Calcutta.

phases can then be calculated. It seems out of proportionally low—about one ten-millionth of our atmosphere under ordinary conditions. Considering the high temperature, the density of an average stellar atmosphere might be but one hundred-thousandths of that of ordinary air. This we would readily admit a vacuum, though in a thickness of hundreds of miles it should abundantly suffice to absorb the ordinary spectral lines.

With this value of the density, we may proceed to calculate the temperature of the hottest stars, which cannot be obtained satisfactorily from their colors, as the latter change very little for great changes in temperature. In this way it is found that the stars with the strongest helium lines (called B3 at Harvard)—like many in Scorpio and Centaurus—have surface temperatures of about 16,000 degrees, while the stars of class B0, like those of Orion's belt, probably run well over 25,000 degrees. A few stars are still hotter, but their temperatures cannot be calculated until further laboratory data can be brought to bear upon the problem.

When the wealth of material which is already in sight or under investigation has been published, and made generally available, we may hope to be able to calculate with considerable certainty both the temperatures and the pressure which prevail in the atmospheres of the stars, and to do this for all the stars, rather than merely for limited groups of them.

The Heavens

The familiar outline of the autumn constellations appears on the map, and is low in the west, with Lyra north of it, and Cygnus above the two. The Great Bear swings low on the northern border, with the Little Bear above, and Draco on the left, while Camelpa and Cepheus are higher, above the pole. Hercules and Gemini may just be distinguished on the horizon—the one caught in the act of setting in the northwest, the other just rising in the northeast. Perseus is high in the northeast, with Auriga below, and Taurus on the right above Orion, which is rising. The great square of Pegasus is high in the south, with Andromeda above on the left. Aquarius, Orion and Eridanus occupy the huge dull region in the south, while the scattered bright stars of the Perseus and Auriga constellations form a permanent ribbon, unattended, low in the southwest.

The Planets

Mercury is a morning star all the month, as it is best seen on the 14th, when he is farthest from the sun. Being, however, only eighteen degrees distant from the sun at the latter date, he is more conspicuous late—about 4° 45 A. M.; but he should be conspicuous just before dawn.

Venus is theoretically an evening star, but is so close to the sun that there is practically no chance of seeing her.

Mars is a morning star, and in the middle of the month is some five degrees west of Mercury, rising about twenty minutes earlier. Mercury, being about ten times the brighter of the two at this time, is more conspicuous.

Jupiter is an evening star setting about 7:30 P. M. at the beginning of the month and now crossing low in the twilight. Saturn is in conjunction with the sun on the 17th, and is invisible. Uranus is in Aquarius, and crosses the meridian at 9:30 P. M. on the 16th. Neptune is in the western edge of the sign, and rises about 1 A. M.

The moon is at her last quarter at 1 A. M. on the 13th, and at the same hour on the 16th, in her first quarter. At 4 P. M. on the 15th, and at 12:30 P. M. on the 16th, she is at her full. On the 17th, at 12:30 P. M., on the 18th, at 10:30 A. M., on the 19th, at 8:30 A. M., on the 20th, at 6:30 A. M., on the 21st, at 4:30 A. M., on the 22nd, at 2:30 A. M., on the 23rd, at 12:30 A. M., on the 24th, at 10:30 P. M., on the 25th, at 8:30 P. M., on the 26th, at 6:30 P. M., on the 27th, at 4:30 P. M., on the 28th, at 2:30 P. M., on the 29th, at 12:30 P. M., on the 30th, at 10:30 A. M., on the 31st, at 8:30 A. M.

At 11 o'clock Oct. 7.
At 10:45 o'clock Oct. 14.

At 9:15 o'clock October 28.

At 5 o'clock Nov. 7.
At 4:15 o'clock Nov. 14.

The hours given are in Standard Time.
NIGHT SKY: OCTOBER AND NOVEMBER

An important extension along this line has just been made by two young and able Englishmen, Fowler and Allard, of Cambridge. Consider a set of stars of a steadily increasing temperature, and the lines of a given element, such as silicon. At low temperatures practically all the atoms will be neutral (with all their electrons present), and almost all of these will have their electrons in the undisturbed positions, where they can absorb some, but not all, of the lines of the spectrum. As we pass to hotter stars, more and more of the atoms will have an electron partially removed, and be in a position to absorb additional set lines, but at still higher temperatures they will lose this electron entirely, and begin to absorb the new set of spark lines, after which a similar process will be repeated—four times in all in the case of silicon.

That such a thing happens was shown by Sir Norman Lockyer, more than twenty years ago. And the harvest which he gleaned from the stars has proved of fundamental importance in modern laboratory work, but now with the aid of theory, it becomes possible to calculate under what conditions of temperature and pressure each set of its lines and spectra will occur. For the cooler stars—like Arcturus, the sun, or even Sirius—the temperatures are fairly well known from the color of their light. And the pressure in the atmos-

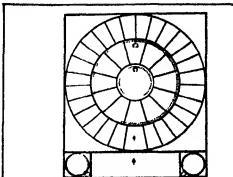


Fig. 1. R. E. Inger's new designed pump in which handling of water is practically eliminated.

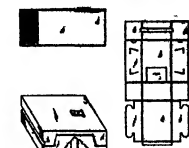


Fig. 2. A novel way of packing folded time paper for invention, derived by L. J. Ames.

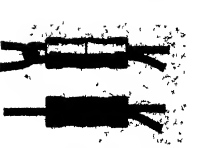


Fig. 3. This device for joining the ends of a cable in the invention of L. Ames.

aplanes have been interrupted in a system of conduits, which rise but positively in case the return of the waste water into the ground in a purified state at a point where it will be absorbed, without the necessity of going to the expense of a large amount of excavating work.

VACUUM BOTTLE.—A. G. HALL, c/o Geo. H. Hark, R. W. corner 4th and Kane Sts., Cincinnati, Ohio. This invention has for its object to provide a vacuum bottle having means for holding a receptacle in position to permit a liquid to be poured therefrom and for absorbing shocks and jars incident to the service for which intended without transmitting such shocks to the receptacle. The device is of relatively simple construction, and may be inexpensively manufactured.

BUILDING CONSTRUCTION.—R. H. INWIT, P. O. Box 28, Portland, Oregon. The invention aims to provide a building especially adapted for use as a garage or for storage purposes. The object is to construct a building in such a manner that space heretofore wasted will be used to the fullest extent and that vehicles stored therein will be readily accessible, and that backing will be practically eliminated, the vehicles after entering the building being placed upon a turntable and brought in direct contact with the compartment to be occupied. (See Fig. 5.)

REFLECTOR.—A. MATTHEW and C. A. MATTHEW, 270 E. 15th St., New York, N. Y. The general object of the invention is the provision of a cheap and efficient reflector for throwing a yellow ray. The object is accomplished by providing a yellow glass and applying to one face a reflecting composition comprising a gold salt and superimposing upon the gold salt a silver salt and a metal which serves to increase strength and stability, and which is applied by an electrolytic process.

WATCH GUARD.—P. H. NORTON, 300 CUNNINGHAM AVE., Jersey City, N. J. Among the objects of this invention is to provide a guard which is equipped with means for preventing the accidental loss of a watch from a pocket. A further object is to provide a guard which can be readily sewed into a pocket and which is simple, durable and efficient in use and comparatively inexpensive to manufacture.

KRALING-WAX STICK.—A. NADEN and R. F. KIRKWOOD, 282 St. John's Place, Brooklyn, N. Y. The principal object of the invention is to provide a sealing-wax stick which when lighted will retain the heat thereon and eliminate the necessity of constant lighting. In the composition of the wax stick a quantity of carbonaceous cellulose fibrous material is used, said fibrous material serving to form a rigid combination which almost entirely consumes itself, the ash or carbon being left in a porous mass, the flame remaining on the stick and burning to melt the wax.

STROBOSCOPE APPARATUS.—J. H. EATMAN, London Bridge Road, England. The object of the invention is to provide a strobo-scope apparatus for use in studying the movement of bodies moving at relatively high speeds in a fluid medium. A further object is to provide an apparatus in which the strobo-scope is arranged at a point differing slightly from the axis of the moving body, so that the light rays are reflected to the eye of the observer.

LOCKING JOINT.—L. W. WHEATLEY, c/o Lester B. Ward Electric Co., New York, N. Y. The invention is for a locking joint which will take the place of the ordinary

mortise and tenon dowel joint, in fact may be utilized in practically any place where it is expedient to join the ends of two members in angular relation. The joint is particularly adapted for use with woven frames and similar structures.

REVERSIBLE CUFF.—R. H. WINDO, c/o S. N. Wilson, Graders Bank Bldg., Lexington, Mo. This invention is for use for shirts, and more particularly in the kind known as "French" cuffs, designed for use with shirts of soft material such as silk madras or the like which are intended to be only slightly stretched, so that they may fold without breaking along the line of fold. The object is to provide a cuff intended to be permanently attached to the sleeve, but which is reversible, and having the same appearance whether folded normally or reversed.

LOCK.—R. E. MATKOR, 104 W. 33rd St., New York, N. Y. The invention relates to a lock which is particularly adapted for use in connection with a telephone instrument, although not limited to this application. This device when in applied position on a telephone instrument, will absolutely prevent the connection of the instrument being used by an unauthorized person. The lock is positively constructed and will not be damaged by the instrument in its connection or disconnection.

CARTON FOR FOLDED TISSUE PAPER.—L. J. AMES, 428 No. 3d St., San Francisco, Calif. The invention relates to means for packing and dispensing folded tissue papers, such as are commonly used in lavatories. The object is to provide a carton which will serve the purpose of a wrapper as well as a dispensing box, thereby allowing the paper to be placed in the carton by the manufacturer and withdrawn by the person using the paper, without necessitating any handling on the part of an attendant. (See Fig. 6.)

CLOSURE FOR TUBES.—C. J. HAY, JACOB MACHINERY CO., New York, N. Y. The invention relates to collapsible tubes. It is one of the objects of the invention to provide a closure for the ends of tubes which are used in connection with a tube neck and cap being constructed as to lock with a partial turn. A further object is to provide a cap which cannot be easily removed, thereby preventing accidental loss of the cap.

METHOD AND APPARATUS FOR PRODUCING IMPROVED IMAGERY.—O. L. CRAMER, c/o Fritz Zschmang, 1 Commerce St., New York, N. Y. This invention has for an object the provision of a simple and efficient means whereby moving pictures can be taken of a given object so that the image of this object in a reflector can be projected on a screen, and the required effect is the camera. The apparatus is inexpensive to make and easy to operate.

WIRETHIN INDICATOR.—W. M. PARVILLER, 1000 10th St., Kansas City, Mo. The invention relates to indicators adapted for use in the detection of wirethins. The object is to provide a street indicator having simple means whereby the same may be adjusted to indicate to the occupants of the car when to stop, and when the car reaches the end of the wirethin, the indicator may be conveniently reversed.

CLIP TYP.—J. L. DEMOREN, St. Weber St., Richmond, Ont., Canada. An important object of the invention is to provide a type which may be used in connection with a severely connected to a gas without necessitating the use of a gas valve. The clip may be applied in a few seconds, and it is

simplest construction and cheap to manufacture.

LEMON AND LIME SQUEEZER.—J. D. WILLIAM and J. R. BOONER, Belvoir Springs, Texas. The object of the invention is to provide a device of this character which is adapted to carry out with facility the cutting of the lemon or lime into sections and the squeezing of such sections as may be desired. The device is simple and durable construction and need not be expensive.

FISHHOOD.—J. R. MASON, R. No. 2, Blue Hills, Texas. This invention relates to hoes and is particularly adapted for use in fishing. An important object is to provide a hoe wherein the foot is of right construction and the handle and foot are provided for imparting force to the server. A further object is to provide means for supporting the server and in such manner that it may readily serve when server is raised.

VANITY CASE.—A. C. MATTHEW, Associated, Cal. Among the objects is to provide a vanity case that is particularly adapted in looks and practical in the arrangement of its parts, that is provided with a mirror all around and has convenient means for carrying the same, the case being completely portable and will be adapted to hold small mirrors.

CONVEYOR.—A. J. SCHWARTZ, 1822 8th Ave., Oakland, Cal. This invention is designed for the purpose of facilitating the work of sealing envelopes in large quantities. Among the objects is the provision of means for opening the envelopes with the material means, and means for driving surplus material from the envelopes after the latter has passed the sealing means.

LIFTING DEVICE.—J. F. FARMER, 1317 Main St., Paterson, N. J. The aim of the invention is to provide a device for lifting heavy loads which a receptacle may be readily gripped, and subsequently lifted by means of a lever and operator extending his hands either by hand or the splashing of a solid or similar substance contained in the receptacle. The device is intended to remove the danger of bruising of the receptacle.

BUILDING CONSTRUCTION.—J. W. KROGER, 85 Federal St., Providence, R. I. The object is to provide a building which is adapted to be used as a minimum amount of time during which it may be provided for the building of a wall, which will do away in a great measure with the use of a crane, and which is simple, durable and cheap.

LAUNDRY BAG SUPPORT.—E. M. KROGER, 85 Federal St., Providence, R. I. An object of the invention is to provide a device which will support a laundry bag in either closed or open position, and which will be adapted for use in supporting from a hook a bag may be removed attached and by which the same may be hung from a hook without the object that a laundry bag may be supplied by referring to the laundry bag.

CONCRETE FORM.—W. J. FARMER, 40 Holland Ave., West Park, N. Y. An object of the invention is to provide a method for forming a quantity of material concrete in a form, and which may be used in such a manner that they may be used in the construction of a building, and which may be used in the construction of a building, and which may be used in the construction of a building.

SWING.—J. F. FARMER, 1317 Main St., Paterson, N. J.

is to provide a motor-driven swing which will do away with the manual operation, and which is adapted to operate a swing which, and to provide a swing which will be adapted and serviceable, simple and of extensive application, in full size for smaller size, it may be manufactured as a toy.

CALCULATOR.—W. M. PARVILLER, Kansas City, Mo. The invention relates to a calculator adapted for use in the sale of all or any article by liquid measure. An object is to provide a calculator with which operations on the second and specific gravity of liquids in temperature changes may be directly read. The device is simple in operation and capable of much use.

FLY SHOOTER.—R. KANNEY and L. HANSEN, 105 No. Main St., Greenville, N. Y. The invention relates to a fly shooter in the form of a pistol which may be employed to kill flies or the like, or which is constructed to resemble a pistol, and is adapted to be used in the form of a pistol, and is adapted to be used in the form of a pistol, and is adapted to be used in the form of a pistol.

SAFETY PIN.—J. W. CANNON, 85 La Grange St., Jersey City, N. J. The invention has for its object the provision of a safety pin which positively prevents accidental extraction of the pointed extremity from the article to which it is applied in front of the displacement of the same from the point engaging same. A further object is to provide a pin which affords a maximum amount of safety in a pin of sufficient size. The pin is of simple construction and inexpensive to manufacture.

BOTTLE STOPPER.—H. J. BRADY, 225 Highland Ave., San Francisco, Calif. The object of the invention is to provide a stopper for milk bottles and the like, which will make a good tight-fitting stopper for the bottle and at the same time provide a means for preventing the stopper from being removed. A further object is to provide a cap in combination with the stopper which can be easily removed without the use of tools or sharp instruments.

DRIP-PAN ALARM.—A. WALLACE, 105 No. 1st St., New York, N. Y. The invention relates to a device adapted to be used in connection with a drip pan, and which is adapted to be used in connection with a drip pan, and which is adapted to be used in connection with a drip pan.

CLOTHES-HANGING DEVICE.—A. WALLACE, 105 No. 1st St., New York, N. Y. The invention relates to a device adapted to be used in connection with a clothes-hanging device, and which is adapted to be used in connection with a clothes-hanging device, and which is adapted to be used in connection with a clothes-hanging device.

STROBOSCOPE APPARATUS.—J. H. EATMAN, London Bridge Road, England. The object of the invention is to provide a strobo-scope apparatus for use in studying the movement of bodies moving at relatively high speeds in a fluid medium. A further object is to provide an apparatus in which the strobo-scope is arranged at a point differing slightly from the axis of the moving body, so that the light rays are reflected to the eye of the observer.

to be made in such a manner that it will be self-acting.

IMPROVED COVER FOR CRAWLERS.—**J. W. BROWN, JR.**, 100 Broadway, New York, N. Y. The object of the invention is to provide a cover for crawlers, which will be self-acting, and will be adapted to be used in a variety of places, and will be adapted to be used in a variety of places, and will be adapted to be used in a variety of places.

CLAMPING DEVICE.—**J. R. KINE, JR.**, 100 Broadway, New York, N. Y. The object of the invention is to provide a clamping device, which will be self-acting, and will be adapted to be used in a variety of places, and will be adapted to be used in a variety of places.

IMPROVED FOR WRITING.—**J. R. KINE, JR.**, 100 Broadway, New York, N. Y. The object of the invention is to provide a writing device, which will be self-acting, and will be adapted to be used in a variety of places, and will be adapted to be used in a variety of places.

MEMORIAL TABLET AND GRAVE MARKER.—**T. H. HARRIS, 406 N. 2d St., Minneapolis, Minn.** The invention relates particularly to a tablet which may be utilized as a memorial tablet either permanently or temporarily, and after temporary use as a tablet or grave marker, the tablet being a substantially flat body with a hinged edge upon its rear face, also a hole at one end for the attachment of a chain.

BOAT.—**A. G. DARR, 224 Centre St., New Orleans, La.** The object of the invention is to provide a boat, which will be self-acting, and will be adapted to be used in a variety of places, and will be adapted to be used in a variety of places.

COLLAPSIBLE STRUCTURE.—**S. WHITE, 221 Union St., Brooklyn, N. Y.** The invention is adapted for use in a structure which may be used as a garage, in carrying and for various other purposes, as, for instance, a temporary shelter for the body on a freight car. The general object is to provide a structure composed of sections adapted to be telescoped and arranged so that they may be taken down or raised, and the structure thereby presenting a variable height.

VANITY CASE.—**G. KENDALL, 112 Market St., Newark, N. J.** The object of the invention is to provide a vanity case, which will be self-acting, and will be adapted to be used in a variety of places, and will be adapted to be used in a variety of places.

DISPLAY TABLE.—**O. J. HERRICK, 221 Union St., Brooklyn, N. Y.** The invention relates to a table designed for holding newspapers, magazines or periodicals in display, and is adapted to be used in a variety of places, and will be adapted to be used in a variety of places.

to be made in such a manner that it will be self-acting, and will be adapted to be used in a variety of places, and will be adapted to be used in a variety of places.

DOOR LOCK.—**R. E. REEVES, 24 Stone St., New York, N. Y.** The object of the invention is to provide a door lock, which will be self-acting, and will be adapted to be used in a variety of places, and will be adapted to be used in a variety of places.

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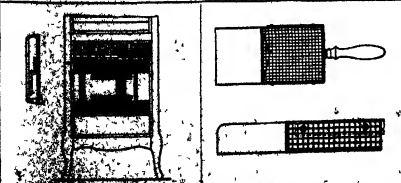


Fig. 1. View of the door lock mechanism, showing the handle and lock body.

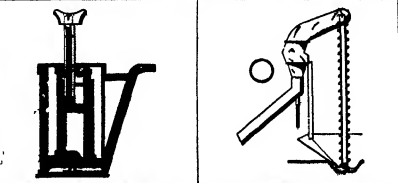


Fig. 2. View of the door lock mechanism, showing the handle and lock body.

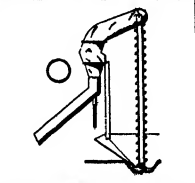


Fig. 3. View of the door lock mechanism, showing the handle and lock body.

may be substantially improved without impairment of a desired movement in providing a full transfer object to its desired position. The desired plate to provide the transfer plates having the gear and the non-slip of the cover, may be secured.

REVERSE MOVEMENT OF MOTOR FOR DRIVING AND DRIVEN ELEMENTS.—O. F. CHASE, 654 Phelan Bldg., San Francisco, Calif. The invention relates more particularly to means for automatically reversing or controlling the direction of motion of driving or driven elements such as a power shaft or the like, and is particularly in the incorporation of the device with the drive shaft of a motor vehicle, but it may be used in connection with various machine elements.

AUTOMOBILE HOOD.—J. M. WELLS, Kalamazoo, Pa. An object of this invention is to provide a hood construction which embodies a double top wall effecting air circulation space for protecting the paint and finish of the outer wall. A further object is to provide means for protecting, sealing and cooling the front of the body immediately under the windshield, the construction is simple and inexpensive to manufacture.

AUXILIARY SEAT FOR AUTOMOBILES.—E. J. GILLEY, 680 Oakland Place, Boston, N. Y. The principal object of this invention is to provide means for increasing the seating capacity by the addition of an emergency seat which is adapted to be partially supported from and in front of the permanent seat, which is in no way interfered with the regular seating capacity, and which includes means of adjustment to render the seat applicable to machines of various types and sizes.

TRACTOR.—F. HOSKINS, 722 18th St., Oakland, Calif. Among the objects of the invention is to provide a tractor-like machine which reduces friction to a minimum, and which includes a sprocket wheel and track-laying links cooperating with the same. The construction is simple, and allows the track frame to ride directly on the hinges connecting the track links without any intervening wheels, or extra ball bearings, and rollers secured to the pins, allowing the track frame to ride with ease.

AUTOMOBILE FLOOR ATTACHMENT.—G. A. MILLER, 90 State St., Brooklyn, N. Y. The prime object of this invention is to provide a device readily attachable to practically all pedal and floor-board designs now on the market, whereby the pedal be for a clutch, brake, or accelerator. A further object is to provide not only a pedal attachment of simple construction, but an attachment which will close the slot in the floor-board in a flame-tight manner without interfering with the pedal action in any way.

CONTROLLER FOR MOTOR.—C. W. PARSONS, 4 Russell Bldg., New York, N. Y. The invention has particular reference to manually operated controllers for the control of a starting box. The main object resides in the provision of means whereby the simple turning of the handle of the controller, in the usual direction will not make the proper connection, but will cause the handle of the starting box being required before the main line potential can be applied to the motor terminal.

AUTOMOBILE BUMPER.—B. W. KERRICK, Box 234, Valley Stream, N. Y. The invention aims for one of its objects to provide a bumper construction which is a maximum of shock absorbing quality without unnecessary weight. A further object contemplates a bumper construction with means for attaching the bumper to the chassis frame, and whereby the bumper may

be readily applied or removed without the aid of a skilled mechanic.

AUTOMOBILE LICENSE BOX.—G. G. AMMON, 167 W. 68th St., New York, N. Y. An object of this invention is to provide a license box and illuminations therefor so arranged that the driver of a motor vehicle by day or by night, should be plainly seen by day through the license box, and at night by the license box illuminations therefor so arranged whereby the numbers of the license will stand out very distinct, and with the parts of the box so arranged that access may be readily had at any time.

AUXILIARY SPRING OR SHOCK ABSORBER FOR VEHICLE. PARTICULARLY MOTOR VEHICLES.—T. E. BOON, and B. N. BOON, c/o Collins & Co., Rockville, South Australia, Victoria. The invention relates to auxiliary springs in form of two curved members arranged in the path of the spring ends, connected, clamping plates enclosing the adjacent ends of the springs extending along the edge thereof, and means carried by the extended portions of the plates for engaging the springs at a point remote from the end and to limit the opening movement of the spring members.

AUTOMOBILE SIGNAL DEVICE.—O. HENNING, 740 Riley Place, Birmingham, N. Y. Among the objects of the invention are to provide means whereby automatic signals can be quickly exhibited or removed at the will of the operator, the necessary medium being electrically assembled on any type of motor without altering the construction of the car. The device is simple and could be manufactured at low cost.

TRANSMISSION LOCK.—J. F. KAZAKA, East Harbor Ctr., N. Y. An object of the invention is to provide a lock which allows facilities whereby the propeller shaft of a vehicle may be held connected with the driving shaft of the engine of the vehicle and the driving shaft of the engine may be separated therefrom, thereby preventing the construction of the car. The device is simple and could be manufactured at low cost.

EXTENSION BODY FOR AUTOMOBILES.—L. SINCE, 892 Broadway, Gary, Ind. The invention is especially designed for the Ford touring car, and is attached to the car in place of the ordinary canvas disposed in back of the seat. A further object is to provide a device which may be extended to carry twice the load which is ordinarily carried. The body may be latched in extended position, and locked when closed, whereby it is draft proof.

LISTER BLOCK FOR MOTOR VEHICLES.—J. P. CANNON, 185 Grove, Iowa. The object of this invention is to provide a device which is adapted to be placed ahead of a motor vehicle wheel to permit easy rotation of the wheel therefrom for elevating the same. It is also an object that upon the wheel being disengaged from the block the motor will automatically operate for holding the wheel in its elevated position.

AUTOMOBILE TIRE.—J. GIBSON, 21 Mason Bld., Brooklyn, N. Y. The primary object of the invention is to provide a resilient tire which includes a plurality of open air cells in the tread of the tire, the desired result without the use of pneumatic pressure, and which is adapted to be applied having instantly and circumferentially applied springs constructed in a manner to absorb the shocks occasioned by travel over a road way.

GAGE-LEAK FORM.—P. M. MORGAN, Chas. Zeiss, Panama. This invention relates particularly to water gage applied to indicate whether or not the water in an automobile radiator has fallen below a predetermined level. An object is to provide a gage which

will enable the driver of a car to ascertain approximately the amount of water in the radiator without removing the radiator cap. **MOTOR VEHICLE ALARM.**—J. P. DOWN, 122 W. 11th St., Brooklyn, N. Y. The invention is primarily directed to the unauthorized removal of a car. The general object is to provide a simple alarm device operated by the shaking of the car as it is being removed, and which is actuated by a transmission mechanism, where the latter is not put in operation by the driver.

BLINDING-GEAR TRANSMISSION FOR FORDI AUTOMOBILES.—F. PANZERER, 122 W. 11th St., Brooklyn, N. Y. This invention relates generally to transmission device for Ford automobiles, the object being to provide a device which is especially useful when the car is in mud, snow, or light slushy country, and will prove highly practical for tourists especially with children, or light delivery trucks.

THREE HOLDER.—D. G. JOHNSON, Box 308, Tacoma, Wash. The invention relates to means for holding a spare tire or tire on a vehicle, and has for its general object to provide a device whereby the tire may be securely held and locked against its unauthorized removal. The holder is constructed in consideration for the convenience of securing and removal of the tire.

STEEL STEERING WHEEL.—V. W. PAKE, 1000 Madison Ave., New York, N. Y. The invention relates to a steering wheel which is capable of swinging or tilting forward, in order that more easy access may be had to the driver's seat of a car, and to provide locking means for securing the wheel in its operative position with the steering post. A further object is to construct a steering wheel so that its mounting may be constructed in order to provide a rigid structure for the steering wheel.

CONTROLLED MECHANISM FOR AUTOMOBILES.—J. A. FOWEL, Maryland, Wash. An object of this invention is to give the operator of an automobile an easier and more perfect control of his vehicle. A further object is to provide a control in which the usual foot pedal is replaced by a hand lever, and a separate lever which directly actuates the clutch and which has a returned and independent movement for throwing the clutch in at the time that the driver takes a arm hold for connecting the power shaft with the drive shaft.

FOOT ACCELERATOR.—A. M. ALLEN, Box 4, Box 47, Valley Mills, Texas. An important object is to provide a foot accelerator which may be conveniently applied to a motor vehicle without substantially altering the construction of the vehicle or marring the appearance of the same. A further object is to provide means whereby the foot may be used for activating the throttle arm of the carburetor without interfering with the hand operated throttle.

IMPROVED POSITION INTERMEDIATE GEARING.—V. W. PAKE, Victor Park Motor Co., New York, N. Y. This invention relates to driving gears for accessory shafts of motor vehicles. Among the objects of the invention are means for feeding a lubricant to the driving gears of the accessory shafts in a manner that its application will be constant during the operation of the motor.

TRIMMED IRON BRACKET.—F. J. ARMSTRONG, 2720 N. 22nd St., Cleveland, Ohio. The object of this invention is to provide a construction of bracket which may be conveniently attached to the brake drum of a motor vehicle, and which is adapted to connect the brake drum and also as a guide for its rod connecting the ends of the

brake band, and in addition will function to prevent lateral displacement of the brake band.

SELF-ADJUSTING HEADLIGHT.—H. H. X. The invention has particular reference to the mounting of a headlight in a manner that the latter will automatically assume a position in line with the movement of the vehicle and in position where the light will be reduced to a minimum. A further object is to provide a device which means which will be adjustable to a number of different means of vehicles.

IMPROVED UNIT FOR MOTOR VEHICLES.—A. RYAN, and J. STEIN, 171 Avenue A, New York, N. Y. The object of this invention is to provide a device for use in conjunction with motor vehicles to cause the application of the brake to stop the vehicle when an object has been struck. This object is accomplished by mounting a bumper on means adjustable, and cooperating with such means means lever releasing means which serve to cause the brakes to be applied. (See Fig. 16.)

VEHICLE WHEEL.—J. J. KERRA, Box 48, Hingham, Conn. The general object of the invention is the provision of a device for use in connection with a vehicle whereby a detachable rim is normally retained in the detachable rim in position where it may be quickly and easily operated by the driver of the vehicle, and which may be removed from the wheel. The object is accomplished by providing on the wheel a plurality of lugs which may be operated by cam means to engage the detachable rim. (See Fig. 17.)

BUGLAR ALARM FOR AUTOMOBILES.—J. H. RUMBLE, 21 E. Maple St., South Troy, N. Y. An object of the invention is the provision of an audible signal connected with the automobile engine through which a fluid under pressure is admitted to pump when the engine is operated by an unauthorized person, whereby the fluid will operate the signal and warn the police and public of the unauthorized operation. Means are provided for maintaining the connection between the engine and the signal until the authorized operator unlocks the alarm. (See Fig. 17.)

TRANSMISSION GEARING UNIT.—V. W. PAKE, c/o Central Y. M. C. A., Middletown, Ind. The object of the invention is to provide a compact unit supported in a housing which is flexibly suspended from the body of a vehicle. Another object resides in the provision of means whereby the clutches and axles on the rotating gears are efficiently balanced to avoid lateral play. A further object is to provide means whereby the gearing unit could be supported from a shaft point on the vehicle so as to permit easy removal of the unit.

TRACTION SHOE FOR WHEELS.—F. P. LINDO, 424 W. 51st St., New York, N. Y. The invention relates to the wheels of motor vehicles, and is particularly directed to the application of a traction shoe on the wheels of a motor vehicle. The shoe is designed for the purpose of extruding vehicle which have become mired or for the purpose of the shoe, which may be applied to the wheels of the motor vehicle in or removed from the driving wheels of a motor vehicle.

VEHICLE FRAME SUSPENSION.—T. W. FINE, Indio, Calif. An object is to provide a suspension means which will bring the frame close to the rear axle and will not cause a suspension means which will bring the axle than other forms of suspension. A further object is to provide a suspension frame which will permit a proper resilient action

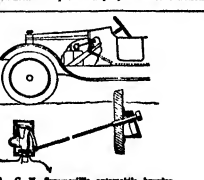


Fig. 15. A. J. Ryan has designed a new vehicle frame suspension.

Fig. 17. J. J. Kerra has designed a new vehicle wheel.

Fig. 16. J. J. Kerra has designed a new vehicle frame suspension.

Good Driving Is Mostly NICE STEERING

HOW TO PARK—HOW TO DRIVE—HOW TO ENJOY YOUR MOTOR CAR MORE

THIS ARTICLE (Continued on next page) SHOULD BE KEPT FOR REFERENCE



The suggestions for the driving of motor cars and street trucks presented here are not intended to be absolute or final. It is understood that exigencies when second which to rules can be laid, on the other hand the applications of the few simple principles outlined here, in ordinary driving, will prove to the driver to meet the emergency situations as they arise.

ATTENTION TO THE JOB IN HAND is first and most important. The good driver is never careless.

TESTING YOUR GUEST IN YOUR CAR AS YOU WOULD IN YOUR HOME is the first point of driving etiquette. It is not only discourteous, but illegal, to risk lives.

In interpreting some of the instructions and suggestions the divergence of State Laws must be considered.

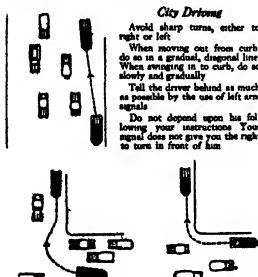
City Driving

Avoid sharp turns, either to right or left.

When moving out from curb do so in a gradual, diagonal line. When swinging in to curb, do so slowly and gradually.

Tell the driver behind as much as possible by the use of left arm signals.

Do not depend upon his following your instructions. Your signal does not give you the right to turn in front of him.



Incorrect method of turning right. Correct method of turning right.

When turning to right at street intersection get as close to right curb as possible before turning.

When turning to left at street intersection get into extreme left side of traffic.



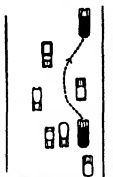
Incorrect method of turning left. Correct method of turning left.

When approaching a street intersection, the Nice-Steerer slows down to a speed from which he can stop quickly.

In turning around in a street where there is much traffic these maneuvers are necessary. In streets where there is little or no traffic, the "Nice-Steerer" can easily turn in two steps, by following the method shown in the diagram.



Incorrect method of turning around. Correct method of turning around.



Incorrect method of turning right. Correct method of turning right.

As a rule it will be found a time and trouble saver to turn about 15 degrees around the clock rather than passing traffic by turning in the street. (This is not allowed, anyway, in many communities.)

MOTORISTS, motor clubs, truck operators, garages, automotive manufacturers and other public officials, not only in the United States and Canada, but in Europe and elsewhere, have so far absorbed 1,744,392 copies of the book, "Good Driving Is Mostly Nice Steering," a 174-page letter of commendation have been received. And the method of distribution has been through reports of actual requests. Nothing better indicates the deep and wide spread interest in good driving, which is mostly nice steering.

It is plain how largely nice steering, as greatly in demand, depends upon ease of turning the front wheels.

—Wherefore an ever increasing number of manufacturers use Timken Tapered Roller Bearings in the steering pivots.

In general pivots, as in transmissions, and on differentials, and on axles, and on wheels, and in front wheels, Timken dominates results from Timken extreme load capacity and responsiveness, and from Timken adaptability for the most exact most delicate motion.

These pages are reprinted from the 12th edition of the book, "Good Driving Is Mostly Nice Steering," made in the Timken Roller Bearing Co., Canton Ohio.



Another opportunity for Nice-Steering presents itself constantly in avoiding bumps, ruts, track-crossings, etc. The steering wheel should be moved not too quickly, the traction is difficult to compensate for, and it impairs all neighboring cars. So long as both front wheels, or both rear wheels, do not hit the obstacle at the same time, the results are not bad.

Street car trucks are at all times, but particularly in wet weather, dangerous to maneuver. If the Nice-Steerer finds himself in the truck, he tips his wheels first to one side, then quickly to the other, and thereby escapes the true as little as possible, while maintaining complete control of the vehicle.

Wet Streets

On wet streets the careful driver is even more careful. Slowing, once started, is hard to stop. Turning the wheels in the direction of the skid will help. But this is dangerous inasmuch as usually there are cars, or children, or cows, in the way.

THE ONLY SKID THAT YOU CAN CONTROL ABSOLUTELY IS THE ONE THAT DOESN'T START!

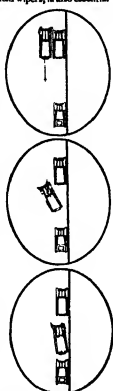
The Nice-Steerer never cuts in quickly after passing another machine. He realizes that the other car is moving also, and he allows ample time before gradually getting back to his place on the right of the road.

Stow, even turn, slow, even stop, slow, even start will avoid skids.

Do not disengage your clutch! Tire chains are of assistance on wet or muddy roads. Clear vision, obtained by windshield wipers, is also essential.

Can You Park?

An easily learned method of proper parking in a limited space is to stop parallel to the curb alongside of the car behind which you are going to park, about one foot outside of it; turn the front wheels sharply to the curb and



back slowly until you can see that by swinging the front wheels hard over to the left your right front fender will just clear the left rear fender of car ahead; turn wheels fully to the left and

back to proper position at curb. This method, once you know positions at which extreme turns are to be made will park you at the proper distance from curb and other cars in one backward movement.

Country Driving

While the "Nice-Steerer" keeps constantly on the alert even while driving through light-traffic roads, the first thing to be learned for comfortable touring or long-distance driving is a safe method of relaxation.

Authorities agree that the safest and easiest grip on the wheel is one hand above the other, one palm up, the other down (See illustration). The grip provides the greatest leverage.

The intermittent use of the hand throttle, on good, open roads, will rest the right foot and leg. The occasional use of the hand brake, besides being an excellent method of conserving fuel, is also expedient and safe.

At no time should both hands be free of the wheel. Small stones, ruts, and bumps will quickly disturb the equilibrium and throw the car in the ditch.

Do not stop (to repair tires, etc.) in the middle of the road, near curves, or near the crests of hills.

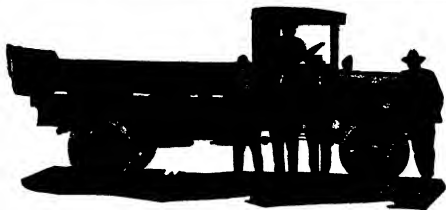
Stones should be removed from the road, after using them to block the wheels.

Starting the Motor

The spark should be retarded. The clutch should be disengaged so that the battery need not suddenly turn over the transmission gears.

It is often easier to start the motor by turning it over several times, with the car stalled, before turning on the switch.





Gets service and satisfaction from Kelly Kats

When sending us the picture reproduced above Mr. G. O. Crump, of Kibler and Crump, Youngstown, Ohio, wrote as follows.

"After using two sets of Kelly Caterpillars on trucks used for road construction we have come to the conclusion that no other tires will give us the satisfaction that Kats do.

"The traction given by these tires has enabled us to operate our trucks without chains over roads where trucks equipped with other tires had hard going with chains. We also have noted the cushioning of Kats has cut our bills for upkeep.

"The above, coupled with the mileage that we have been getting, have proved that your tires are the most economical we can buy."

Owners of heavy and medium duty trucks are invariably delighted with the service they get from Kelly Kats because they are especially designed for trucks of these types.

Wherever heavy loads are hauled, wherever road conditions are bad, and wherever the ability to stand punishment is a necessary quality in tires, Kelly Kats are unequalled.

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that it will not exceed a fraction of the cost of lime. The exact nature of the softening material is, however, not being ascertained at present until some patent uncertainties are cleared away.—*Food Products*, 23 13, pp. 30-42.

A New Bleaching Process has been developed which, it is claimed, is less than half the time usually consumed in bleaching without the use of lime or strong acids, will eliminate all specks, notes, abrasions, etc., from raw cotton, cotton yarn, and cotton piece-goods, and will give the goods a lasting soft white finish that will not turn yellow with use. It is a clean, sanitary process, easy to use, requires no change in equipment, and affords a great saving in cost. The process consists of dissolving the bleaching powder in cold water, putting the solution into the vat filled with boiling water, and then putting in the goods, which are brought to the white in about three hours. The bleaching liquor is then drained off, the vat refilled with hot water, and the goods squeezed off and dried in the regular way. The powder, mixed with cold water, releases a gas when put in boiling water that permeates the textile material and destroys impurities.—*Color Trade Jour.*, 13 1, p. 32.

Mechanical Engineering

Metal Polishing Investigated.—Research carried on by Stanford University on metal polishing indicates that its three sharpest abrasives are silicon carbide, artificial corundum, and carborundum. Of these, the most durable was artificial corundum, thus came energy that would break down at a very rapid rate and the surface became smooth very quickly. There are indications that in polishing the actual atoms of the metal are sloughed away and they become so mobile that they are actually in a fluid state.—*Chemical Industry*, 4 7, pp. 201-2.

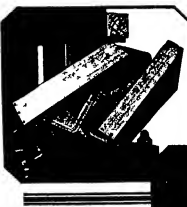
Temporary Ductility of Sheets of Milled Steel may be obtained in a small degree by heating them slightly before the work is performed. Milled impurities harden and brittleness to iron making iron-silicon alloys of more than 8 per cent carbon is unmanageable when castings can be annealed. When the silicon content exceeds more than 4.2 per cent the sheet is too brittle for punching and shaping, and if shaped it often breaks along a longitudinal ridge in advance of the cutting tool. Temporary ductility may be obtained by carrying on cutting or deformational operations at temperatures slightly above atmosphere, the temperature depending on the steel composition. Brittleness, however, is modified only slightly by heat treatment. The effect of several alloying elements in alloys raises the critical ductility temperature aluminum likewise raises it, while manganese lowers it.—*Iron Trade Jour.*, 73 2, pp. 107-10.

A New Method of Inspecting Steel by its magnetic qualities is outlined in the *American Ironmaker*. By a combination of two high-potential magnetic drive tests were made on the hardness of cold-rolled steel. The test is too destructive and it is possible to evaluate the internal changes even without structural changes. The method is believed to be widely used and it has found successful commercial application during the past two years. It has enabled the manufacturer of a better and more uniform product with practically no change in equipment. It results a rapid test with portable apparatus and commercial alternating current. A single measurement can often be made to read the desired combination of such qualities as strength, hardness and brittleness.—*Am. Ironmaker*, 60 2, p. 146.

Machine Shop Developments of the present year include some very definite tendencies. There has been a noticeable increase in the use of special machinery, with the tendency away from the single-purpose machine. There has been an increased use of the single-pulley drive, the individual motor drive, and transmissions of the automatic developed rapidly. There has been an increase in the development of safety devices, in the use of brakes to stop revolving spindles quickly, in the use of roller and ball bearings, in the adoption of hydrostatic feeds and hydraulic drives and in the use of rapid traverse. Footproof construction has been highly developed. Grinding machinery has developed rapidly. Another important tendency is the growing use of the centerless grinding method. There has been increased use of the open-side plunger, a leading toward the crank press for hot pressing and hot forging, the development of washing ma-

(Continued on page 622)

Proved by Test Not by Argument



SPECIFICATIONS

Nailed Wood Box
Sides top and bottom 3 1/2 in
Ends 1 1/4 in
Maximum Load 67 pounds
Lumber 2x4's, Strength 100%.



SPECIFICATIONS

Pioneer Box
Sides top and bottom 3 1/2 in
Ends 1 1/4 in
Maximum Load 1783 pounds
Lumber 2x4's, Strength 100%.

These illustrations are reproduced from photographs of box tests made under the supervision of the United States Department of Agriculture at the Forest Products Laboratories.

WOOD boxes and crates are recognized as the strongest practical containers. A box made of any other material and in general use would have failed in this diagonal compression test long before the nailed wood box did at 957 pounds pressure.

But the Pioneer Wirebound Box, using less lumber and weighing one-half as much, withstood a pressure of 1783 pounds.

This visualizes the great strength of Pioneers as their extreme lightness 20 highly desirable features.

Our box Engineers will be glad to study your requirements without cost or inconvenience to you. If you cannot use Pioneer Boxes or Crates they may be of help to you in other ways. We make all types of wooden shipping containers. A bulletin on boxing and crating—"General Box Service"—will be sent free upon your request.

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Electrical Notes

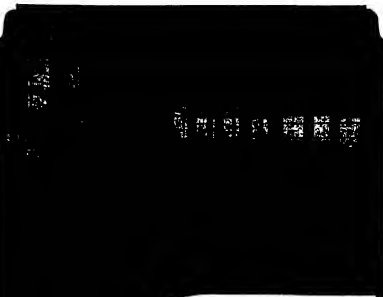
Simplifying Bell Systems.—From England comes a good suggestion in the way of a self-contained bell outfit for use in the home and shop and factory. Ordinarily, it is pointed out, the electric bell uses considerable lampness in biasing the battery, as it seems, with the result that at some future date one may be quite troubled seeking the battery which requires renewal. Several English manufacturers have introduced in the bell and battery boxes in one unit, with terminals which are merely connected to the wires of the bell ringing system. In this manner the battery is always at hand and convenient for inspection and renewal, which will doubtless prolong the effective life of the battery and make replacement cheap.

Mechanical Rectifiers.—From a recent issue of *Elektrotechnik und Zellschicht* we learn that sparklessly vibrating mechanical rectifiers are capable of delivering singly or with two vibrators in parallel up to 1½ kilowatts of direct-current at 100 volts, which is sufficient to feed projection arc lamps or charge large storage batteries. Thumping contacts careful tuning of the vibrator and condenser to remove the contacts during a sparkless operation. It is claimed that these rectifiers are much cheaper than motor-generators, and have at the same time a considerably higher efficiency. For an output of up to six kilowatts, the German author suggests the use of rotating commutators, driven by and mounted upon the shaft of a fractional horsepower motor, self-starting synchronous type. Such a rectifier for a capacity of 5000 ampere direct current operates with an efficiency of more than 70 per cent.

Automatic Telephone System in South Africa. keeps pace with the spreading telephone network. The telephone system throughout the world. Automatic telephone exchanges are being installed at Stellenbosch, Elizabeth and Witmaritzburg. It is intended to extend the automatic system throughout South Africa, as the existing lines require replacement. The post office authorities have been advised as to the matter of up-to-date telephone installations but have been handicapped to a considerable extent by financial considerations and the holding up of all development during the years immediately following the war. The automatic system offers the outstanding advantage of enabling an all-night service to be given in places which cannot obtain such service with the manual exchange. It is generally assumed also that it will be much less expensive to maintain than the present system.

An Electrolysis Investigation has been undertaken by the Bureau of Standards in the city of Galveston. This investigation is cooperative in character, all of the utilities in Galveston which were concerned in the electrolysis problem having arranged to participate in it and cooperate actively with the Bureau in making the tests. The primary object of the work is to secure additional data concerning the application of the earth current meter to electrolysis testing. It is pointed out that the results will demonstrate further the utility and necessity of employing this method and instrument where reliable information as to electrolysis conditions and a quantitative measure of the degree of hazard are required. The investigation is, therefore, mainly one of fundamental research although it is expected that considerable detailed information regarding the local electrolysis conditions will be obtained, and a study of the effectiveness of mitigative measures will be made.

Small Ear Telephone.—From the *Electrical World* we learn that a radically new telephone construction has been put on the market by a German concern, primarily for the use of persons who are deaf of hearing. The customary standard receiver, which is held to the ear by a steel strap, not only causes painful pressure upon the bowl but attracts unnecessary attention to the impediment of the bearer. This new telephone might be called rightly the smallest ever built. It measures only about an inch in length, and its open end is to be inserted into the ear, being held there by proper shaping of the end piece. Being of such small dimensions, it was not possible to use an iron diaphragm for the sound generator. A fine piece of specially treated skin with a thin piece of iron fastened to its middle serves as a membrane. The voice reproduction is claimed to be excellent, and it is so-



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Heat is a newer and better way to heat your plant. Skinner Bros. (Batz, Patent) Heater follows none of the principles of old time, unsatisfactory heating methods—it is revolutionary in design—the pioneer of its type.

Because of the simplicity and soundness of the Skinner Bros. (Batz, Patent) Heater design, it will heat every part of the open area of your building at all times—regardless of weather conditions, exposure or type of building construction. Satisfactory performance is guaranteed.

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Complete \$97.50

Wild shouts from the crowd—

"Hold that line! Hold that line!" Every play—every cheer from the rooting section. Clear and loud and real. With a Radiola.

It must be a Radiola. Look for the mark. When the "bunch" comes round to get the scores—you know your set will work. When the club holds open meeting, and the club room's filled—you can count upon it—

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Whether it's a one-tube Radiola, or the stately Radiola Grand, the name with the backing of the greatest research laboratories in the world stands for quality in every point of make, finish and performance.

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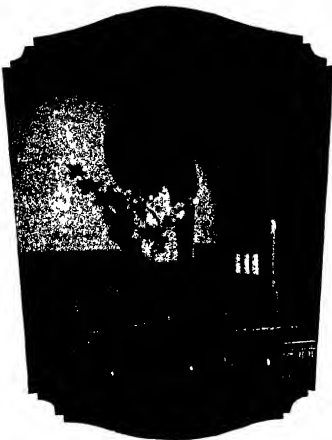
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Mr. M. J. Deberry of Oak Park, Ill., writes: "Many nights I hear Station WJH (Los Angeles), CFCN (Calgary, Canada), WEAU (New York) and others as far away. In one evening of four hours and twenty minutes I heard 30 stations, scattered all over the continent. These stations were a total distance of 20,375 miles from my home."

Many wonderful and unsurpassed distance records have been made during 12 years wide use of Tuska-made radio instruments.

Tuska Popular No. 225

3 bulb Regenerative Set. Piano finish mahogany cabinet. Amplifier switch. Concealed binding posts. Armstrong circuit, licensed under Patent No. 1,113,140. Price \$75, without tubes, batteries or loud speaker. Ask for special circular No. 205, describing this set.

*Let the
day's troubles
sink with the sun*

THEN turn to your Tuska Radio, and be whisked around the world as if by magic. A touch of the dials, and you are in Davenport, listening to a singer with a voice like a nightingale. A slight movement brings you to Philadelphia to hear the rolling, majestic music of the greatest organ. Regretfully, you turn away, to pick up the latest flashes of news from New York. In those few precious hours between work and sleep, you live in Radio Fairyland, where you are master of distance and ruler of a host of entertainers.

Will you give your family or yourself the pleasures of Tuska Radio, which educates, soothes, amuses and takes all of you traveling inexpen-

sively? Here is the receiver that always works, that annihilates miles, that brings in music and voices sweetly, clearly and undistorted. It is the ideal set for busy people who want the thrills of radio without the tinkering.

For a dozen years, Tuska-built radio receivers have been famous for advanced design and painstaking New England workmanship. The Tuska receiving set of to-day is not only up to date, it will still be good for service in five years or more. Tuska Radio will give you hundreds of dollars of value in joy for every dollar it costs you. It will never disappoint you or your company. We will send you the address of nearest Tuska dealer on request.



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TUSKA RADIO



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*Try them tonight
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—that easy chair hour
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PALL MALL Specials
New size—plain ends only
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Wherever men smoke, Pall Mall is known as the aristocrat among cigarettes. Its exquisite blend of the choicest Turkish tobaccos has never been successfully rivaled.

Now Pall Mall comes to you in a new size package—priced so moderately that even the thriftest may smoke it consistently—a super-value Pall Mall—made possible by greater output and new efficiency in manufacture.

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Try them tonight in your easy chair hour that hour after the day's work when men demand the most from a cigarette. Give Pall Mall the "Luxury Hour" test. Soon you'll smoke them exclusively. New size in plain ends only.



20 for 30¢

WEST OF THE ROCKIES 20 for 35¢

Scientific American Digest

(Continued from page 287)

addition, it was discovered that a greater fecundity was obtained by a progressive increase in the velocity resulting from increasing the size of the nervous—*The Owl Industry*, G. L. pp. 217A.

Natural History

Bird's Egg Banned From Trade
1100 Miles Safely.—A procer of Cape May, New Jersey, received a bunch of eggs from Cuba in which there was a bird's nest containing one egg. The egg was not broken although it had come 1100 miles.

Resumption of Fish Culture in Russia.
From a recent letter addressed to the Secretary of the American Fisheries Society by N. Novorossi, director of the All Russian Agricultural Museum, formerly the Imperial Agricultural Museum, at Petrograd, we learn that the long inactive fish-culture apparatus at the museum has again been utilized. Mr. Novorossi states that, with the cooperation of the chief administration of the fishery and pisciculture trade, there was founded last autumn in Petrograd, on Krutovsky Island, the first State fish hatchery. Though the early approach of winter prevented the best results, 2,000,000 eggs of *Alburnus*, 8,000,000 of *Carassius auratus*, and 6,000,000 of *Alburnus* were obtained and successfully incubated. Mr. Novorossi further states that it is the intention to materially enlarge this sub-aquatic establishment during the present season.

Domestic Animals in a Zoo.—We once shuddered the learned director of an eastern "Zoo" by suggesting that domestic animals would perhaps prove as educational as the exotic, but he frowned sternly on the idea. Logical parts were for wild animals alone. Our judgment now proves that he has been good for something after all. Following suggestions that a cow and a pig be placed in the 84 Louis Municipal Zoo, because many St. Louis children have never seen either, superintendent of instruction Madors instituted a poll of sixth grade pupils. It amounted that of 5758 children questioned 40 per cent had never seen a sheep and 17 per cent had never looked upon a pig. Twelve children out of every hundred had never seen a cow.

Alberta Bird Sanctuaries.—Seven bird sanctuaries have been established in the Province of Alberta by the Canadian Government in cooperation with the provincial authorities. Completion of the fisheries and sanctuaries is near and a survey is to be made to locate suitable areas for bird sanctuary purposes in the Province of Manitoba.

A "Monkey Mountain."—The Park Commissioners of Milwaukee, realizing that monkeys attracted and held the attention of visitors to the Zoological Garden longer than any other exhibit, erected an oval-shaped mound, suggestive of a mountain, 127 feet long and 62 feet wide, where the primates may be viewed under as nearly natural conditions as possible. On the south side of the mound a concrete cave was constructed with an above facing south. This gave a large open space, protected from the north, west and east winds in the spring and late fall. At one end of the mound an series of rock shelves about four feet wide, upon which the monkeys sit themselves and where they also receive their food. From the highest point on the mound a rivulet flows, winding its way outward over rocky patches in most lower, which it terminates in a fairly extensive pond, in which the monkeys can bathe in the sun. The entire surface of the mound, with the exception of the sand beach, is matted. The most surrounding the mound is 80 feet wide, on its outer side all has been on concrete to prevent the escape of the monkeys should they desire to reach the street. The place is so arranged that it is possible for 4000 visitors at one time to enjoy the interesting activities of the monkeys under natural surroundings.

The Zoological Museum for Feline.—Although the widening of our knowledge of the fauna, living and extinct, of Asia and the enrichment of the collections of the American Museum of Natural History was the major purpose of the Tibet Ladak Expedition. It has not failed to recognize its opportunities in the study of zoogeographical activities in the country where its field work is being pursued. It has already at least a portion, warmly open-

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Saves \$13,000 a Year!

809810 Invented in six Powers Automatic Temperature Regulators, like the one shown above have increased the profits of Lyon & Healy, Inc., of Chicago, \$12,123 a year. These regulators control the heat in wood-drying kilns and have been in operation for 8 years without repairs of any kind. Drying time has been reduced from 24 to 16 days increasing capacity of kilns 60%, and saving 135 days drying time a year, and saved amounts to \$3,962; saving of lumber formerly spoiled by "warping" and "checking" amounts to \$8,740; and 1/2 of foreman's time is also saved. These are the chief savings of this installation which appears in a report of investigation made by J. H. Gould Co., Chicago. We shall be glad to send you a copy of this report and to show you how automatic temperature control will increase your profits when applied to any process requiring a steady, uniform temperature.

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served by President Henry Fairfield Osborn, of establishing in Peking a museum of natural history. It is to be hoped that the most universal in China will not affect this admirable idea.

Will the Nightingale Sing at Noon?
Last year an American ornithologist went to England especially to hear the nightingale sing at noon. That was the first visit for the purpose and unlike the other two was successful. The idea was so well advertised in the newspapers that the most of the nightingales was no great rarity according to the letters which Dr. Wood received. The whole thing seems to be a matter of habit and those who are looking for this ornithological treat can find no better hunting ground than Surrey.

Summer Fawn Agitation.—The wearing of summer furs has again engaged the attention of scientific societies and the curtailment of winter furs is also advocated. Among the organizations which have now started to cooperate actively with the object of amassing settlement on the subject and later make legislation are the American Museum of Natural History, the New York Zoological Society, the House and Crockett Club, the American Game Protective Association, the American Bison Society, the National Association of Audubon Societies, the United States Biological Survey, the National Park Service, and the American Society of Mammalogists.

The Fox Industry.—Fox raising has been an profitable in Western Canada and that the industry is now extensively carried on in Southeastern Alaska. The shipment of furs and skins amounted to more than \$2,000,000 last year. Most of the amount is represented by blue and silver furs.

How Males Live.—The American Museum of Natural History offered a prize of \$25 for a nest which would show how the male lives, and several were forthcoming. Dr. F. A. Lincoln, Director of the Museum, said accurate information hitherto not available in scientific, had been secured. "This is the first authentic information about a male's nesting habits that I know of," he said, "and for the first time we know where we can make out of our specimens." He will be the first in any and any one which was unable to find any one who knew anything about the family life of a male bird. I received the accurate information of the finches of the nests we now have." Dr. Lincoln plans to use the newspapers in further hunts for unusual specimens of animal life. He said that for three years he has been trying to get hold of a family of young raccoons under a month old. In spite of a reward of \$100 for such a family he has never been able to get one. He is also after a family of young voles.

An Aquarium for London.—Aquariums have come and aquariums have gone in London, probably because they were once municipal ventures and were not handled by scientists. Now, however, the Council of the Royal Zoological Society has decided to provide an aquarium in London under the direction of a trained biologist. The Marine Biological Station at Plymouth is a long and elaborate journey from London. It is very fitting that the Royal Zoological Society should sponsor the undertaking as the New York Aquarium is also under control of the New York Zoological Society.

Prevention Better Than Dentistry.—The Royal Zoological Society which runs the "Zoo" in Regent Park, has a new curator and one of the first things he did when he assumed office was to put the spot on a diet of hardwork so as to save their teeth, which were becoming sore from a diet of bananas, potatoes, oranges and bread. The trouble seemed to be a loosening of the teeth like prosthodonts. The unwilling boarders at the Zoo take to the hardwork and seem to prefer it to the soft food.

Archaeological

Early Postal Service.—The history of the postal service goes back as far as the sixth century B. C. and may be called the landmark of civilization. We can trace it from the dispatch bearers of the Assyrian and Roman times to the airplane service of the present day. In the Book of Esther in the Bible you will find two letters were sent thousands of years ago. There it tells of how King Ahasuerus, turning from Queen Esther that Haman had ordered the death of all the Jews in the land, commanded Mordecai to send messengers to the cities and send letters to every province of the kingdom.



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Travel and Exploration Notes

Desert Raids "Lessons" Borne.—Motor omnibuses are now running regularly between Bagdad and Aleppo, although the motor road is officially unprotected. The distance between Bagdad and Aleppo via Mosul, is roughly 600 miles. The buses meet eight passengers. The omnibuses run via Mosul and take five days, although ordinary cars traveling up the Euphrates Valley take only three days. The provincial desert shahs have undertaken not to molest the omnibuses in return for a lump sum down.

Robinson Crusoe a Dutchman?—Idols are being smashed with great regularity these days. Eleven years before Defoe landed Robinson Crusoe on the inhospitable shore, one Hendrik Rowena, a Dutch surgeon, wrote a book of adventure which parallels the English Robinson Crusoe so closely that the claims of the prolific English writer may be assailed very carefully before we reject "Rinche Gabbler," the Dutch forerunner. This book has just been published in translation by Lucius J. Hubbard.

The Nihilist-Negroed Fair Revisited.—The Nihilist-Negroed fair, perhaps the oldest of the world's gatherings for the promotion of trade, opened this year on the first of August. Traders from Persia, Bokhara, Turkistan, Afghanistan, Mongolia, and the Far Eastern Republic were encouraged in all possible ways to come and bring their goods, and Russia was represented by a number of state trusts and syndicates. Soviet economic councils, and cooperative societies. The fair dates back to the fourteenth century. It was then held at Kanan. For the last 100 years it has been held at Nihilist-Negroed, a small town at the junction of the Volga and Oka Rivers, about 200 miles east of Moscow.

MacMillan Party is Safe in Arctic.—News that the Arctic expedition headed by Donald B. MacMillan spent the winter in southwestern Baffin Land and was successful in its observations in terrestrial macmillan has been received at Portland, Maine. The raftsmen, dated July 27 said that all members of the expedition were well. The radio receiving outfit installed on the schooner "Boronia" has proved ineffective. The men, sent out from Nainok, by way of Fox Island, Newfoundland, reads as follows: "Wintered southwestern Baffin Land. Observations successful. Operation beginning November. Sixteen field stations. No polar light photography, hope secure some Labrador. Can wireless us through Fox. Trade Commission message delivered Tuesday." Copy forwarded to the southwest end of Baffin Land and at the upper end of Hudson Strait.

A Patagonian Fossil Hunt.—A five-year hunt for fossils of extinct species of mammals which appeared some ages ago, will begin in October when Prof. Elmer H. Reade, associate director of paleontology of the Field Museum of Natural History, of Chicago, and three assistants will sail for Buenos Aires on the first leg of their expedition. After exploring the Argentine pampas, the party will strike southward along the Atlantic coast as far as the Straits of Magellan. In places the work will be along beaches where the bones are accessible only a few hours each day. In the extremity of Patagonia, a land of strange legends and folk-lore, the party will search for fossil remains of extinct mammals, more ancient animals, which existed in South America in the ages when it was almost as widely separated from North America as Australia is now separated from India. This isolation accounts for strange results.

Across the Empty Continent.—Two explorers, 70-year-old twins, by the bye, have just crossed Australia from South Coast to North Coast and back covering nearly 6000 miles in 67 days three motor cars. The explorers passed through vast stretches of country without sign of man or beast or experience. Captain White considered, who most strikingly justified the late Lord Northcliffe's lament over the futility and monotonous of the "Empty Continent." Mr. McCullum, one of the two brothers, says he was amazed at the abundance of fertile country through which they passed in the interior, and mentions one plain 150 miles long and extending east and west as far as the eye can see, containing of splendid alfalfa soil. They passed through superb pastoral areas with many rivers available for large irrigation schemes, but the development of these lands would be absolutely dependent upon the building of a direct north-south transcontinental line.

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Protecting Our Great Banks

(Continued from page 282)

of trained assistants and the fullest liberty of action and freedom from interference. Consider complete this confusion.

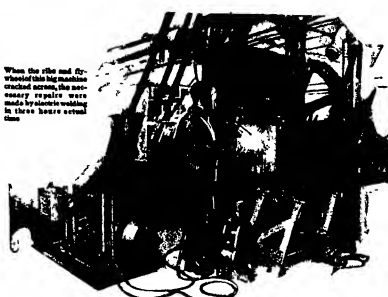
Many bankers, when made acquainted with this fact, have recoiled from expensively constructed vaults and taken the stand that much cheaper structures will hold back the expert crackman for just as many hours here again is a truth. The same expert who can make his way through the finest vault wall yet designed in, let us say, five or six hours, will require just as much time to get through much sturdier and far more economical barriers.

But the man who stops his reasoning here and puts in the cheaper vault is deluding himself none the less. His cheap wall may resist for just as many hours as the great metal and concrete walls recommended by the engineer, but there are ten thousand burglars and a hundred thousand ordinary mechanics in the country who can breach his cheap wall in a few hours with only ordinary tools, such as are easily transported and assembled. On the other hand there are only six men in the United States who can make their way through the modern wall in the same length of time, and they are all heavily paid experts in the art of standing. Moreover, they would need for their work a huge equipment of modern tools and machinery such as could not possibly be handled or even possessed by criminals.

The matter simmers itself down, therefore, to a question of odds, which stands in favor of the extensive vault in the ratio of a hundred thousand to six. The heads of the great banks understand this and equip their institutions accordingly. Nor can these chiefs of large financial institutions find the government officials to be any doubt. Big city banks put in modern vaults which cost as much as half a million dollars, and the Federal Reserve branches have spent as much as a million dollars for this kind of protection in a single bank. Such amounts are not laid out for doubtful returns.

I have already written extensively of the burglar alarms as applied to business banks and banks, but the installation of the wonderful device used in our greatest financial institutions requires special description and explanation. They are not less marvelous in their way, than the vast vaults of which they are now an integral part. My readers must already understand that the lining of a modern vault is electrically connected with an alarm which goes off either if the lining is perforated even so slightly or if it is forced by hand. In addition to this lining, the door, front slides, top and floor of the modern vault are thoroughly interlaced with the wires of the alarm system or system, two separate installations being now employed in some of the best vaults. These wires, enclosed in leaden sheaths, are laid when the reinforcing rods and cables are put into place and the concrete is then poured over them. They are similarly built into the great doors, so that every corner of the vault is interlaced with this network of alarm rings. There are, as previously explained, two general types of such systems, the central office system, under which the alarm is given at a patrol house, and the local or public alarm system, which sets off a loud siren fixed to the front of the bank and enclosed to a steel in place to prevent burglars from tampering with it before attacking the vaults. There is, of course, considerable argument as to the respective merits of these two alarm methods and it is not within my province to express an opinion on either side. I am indebted for the information to Mr. W. R. Whitely, the noted Boston expert on this subject. In addition to the vault walls and the wiring in the doors and walls of the vaults, used to protect against nocturnal burglars, there are just business matters throughout the banking rooms and in various other parts of the institution, present any one of which will set off the general alarm instantly in some of the largest banks.

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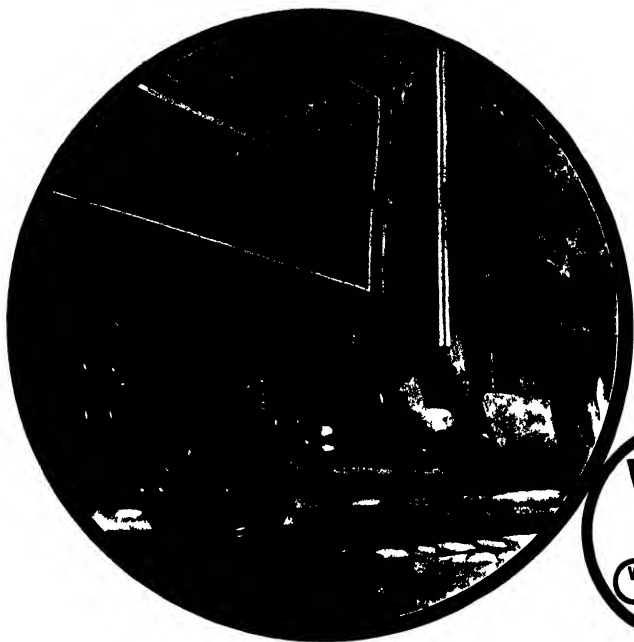
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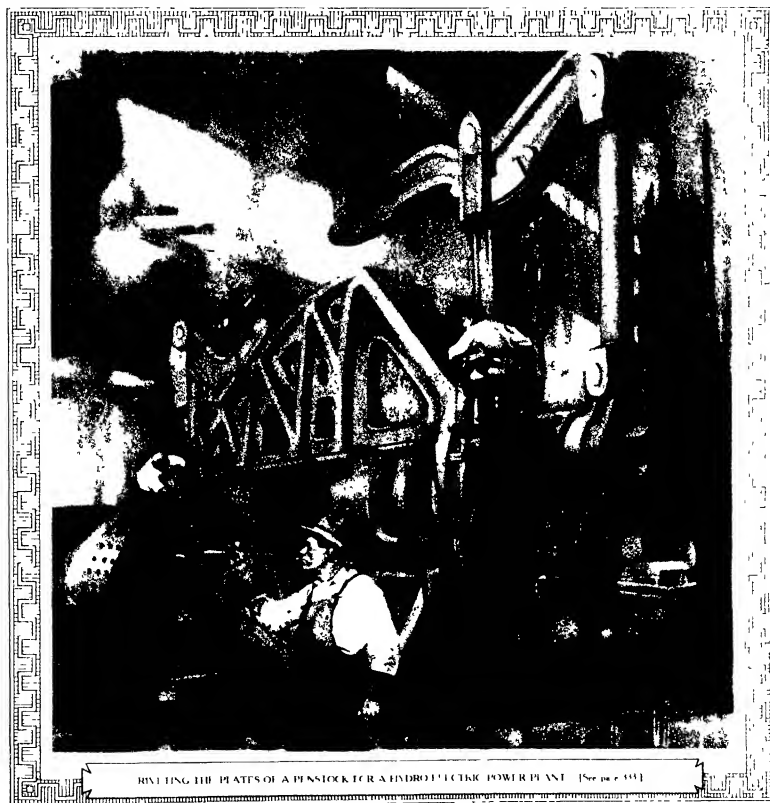
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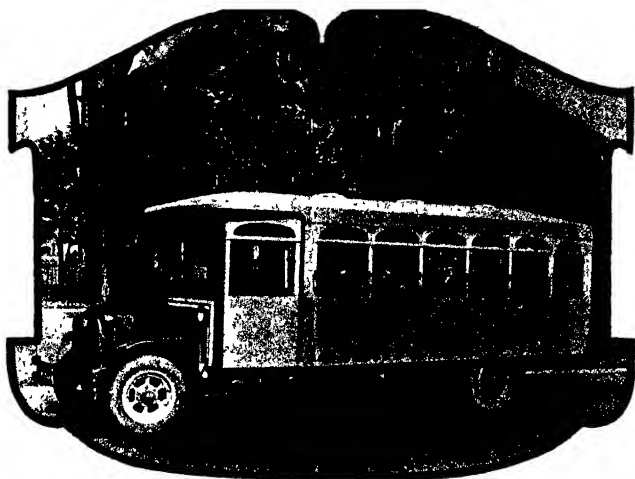
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With the Editors

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THE fiftieth anniversary of that indis- pensable tool of modern business—the typewriter—was recently celebrated. At the time we carried a full page of typewriter photographs, selected with a view to depicting the progress of this most useful invention. And now we have something more to add to our brief review of the typewriter evolution. During the years 1867 to 1868, Alfred N. Busch, the editor of the *Scientific American*, invented a number of machines. The most noticeable feature which will strike the typist of today is the key-rod passing through the bridge, the bell-crank lever pulling the connecting wire, and the pivoting of the type-levers. With this illustration before him the operator might very well wonder wherein the inventions of the past thirty years have advanced the essential theory of the typewriter. But Busch's machine was not intended as a writer paper and simple. It was used to embrace a narrow paper tape. This tape fed through the center of the machine, and the type-levers themselves worked in pairs like the pair of tongs. When a key was depressed, the lower bar rose, and the upper bar descended, and gripped the paper between them. On one bar the letter was in relief, and in the other it was sunk, so that the paper was forced into the exact relief by the pressure of the ink in the relief. The type-bars all converged to a common center, and the paper was fed by a completely independent clockwork mechanism, the operation of which was controlled by a cord, which, passing beneath the type-bars, received a pull whenever any of them was depressed, and allowed the train of clockwork to advance the paper the space required to embrace the next letter. Thus we have a third state in the evolution of the machine, namely, the equivalent of what we now call the universal bar.

SO once more we rise to how in acknowledgment. In the past, as in the present and the future, we have not always been satisfied to serve merely as a chronicle of the advance of science. At times we have gone quite beyond the bounds of journalism and have taken a hand in the development of a given invention, or even in contributing our ideas and suggestions to the workers in that particular field, or by conducting joint investigations and studies which have resulted in helpful conclusions. We have every reason to believe.

FOR the present, our psychic investigation and our Abrama electronic researches investigation are engaging our post-journalistic efforts, so to speak. In this issue will be found an interesting account of how Dr. Geley, the well-known Director of the Institut Metaphysique International of Paris, obtained the famous Frank Kluhl's words which have attracted so much attention in and out of our circle. The original manuscript, written by Dr. Geley in French, his native tongue, has been translated by Mr. Stanley de Bruth, a well-known British engineer who has rendered into English such formidable works as Richey's "Thirty Years of the History of the Electric Light," and the "Electricity of the Electric Light." Mr. de Bruth has been a close student of psychic research, and our readers are assured of a translation that will not suffer through any lack of special knowledge of the subject on the part of the translator. Numerous investigators have claimed to duplicate Geley's results, working with heated rubber gloves. It

these have grown fairly to duplicate the severe test conditions prevailing during the production of the originals.

IN this issue, too, there appears the report of our first formal test of the Electronic Reaction of Abrama's method of diagnosis. This first test was of the most elementary character, and we were prepared to follow it up immediately with others surrounded by more difficult conditions. Yet, singularly enough, the electronic reactions diagnosed in this instance, who claims to use the genuine Abrama methods and who certainly makes use of the Abrama "radio" charts and other Abrama technique, all but failed completely in his diagnosis of pure genui culd. The report makes unusually interesting reading, but it is well to caution the reader that this test must not be considered conclusive. For more work must yet be done before we can begin to form into an opinion as regards the merits of the electronic reactions of Abrama diagnosis and treatment.

WE are fortunate in being able to present in this issue two articles on topics of the first importance, which have been written for the *Scientific American* by our own Admirals of our Navy. They are, moreover, important as the time has been set for this year as Navy Day, and everyone knows that the Navy has never been so important in the history of the United States as it is today. It is a happy friend that the great man whom it is his honor. The tribute of Admiral Sims to Roosevelt's influence in building up the Navy both in its material and personnel, is particularly valuable because of the fact that the Admiral was Naval Aide to the President during the time when notable reforms in target practice ship design, and so forth, were made, and he speaks with luminous knowledge of the facts. It is quite unnecessary to say anything in re of Admiral Sims' record. He was chosen to represent the Navy abroad during the World War, and the great service he rendered in this difficult position as a matter of record.

R EAR ADMIRAL GLEAVES is another naval officer who stood out conspicuously because of his war services, for he was, with headquarters at Hoboken, had charge of the great and difficult task of putting two million of our American soldiers across the sea, and bringing them home again after the Armistice. There can be no finer tribute to the Admiral than the remarkably successful way in which this difficult war was done. The Admiral, as our readers will note, has a truly literary pen, and among his best works is a life of Captain Lawrence of the Chesapeake, which should be read by every student of American naval history.

FROM Sir Oliver Lodge's own pen we learn something of the wonders of the atom, with the little universe of its own, in the article entitled "Within the Atom." Sir Oliver has the happy faculty of handling science in this instance he takes the otherwise intricate subject of electrons and protons and converts it into a history of interesting story which may be read by laymen and physicist alike. We hope to have other articles from the pen of this great scientist, who, contrary to the general rule, knows how to express himself in a style which is as entertaining as it is understandable to everyone.



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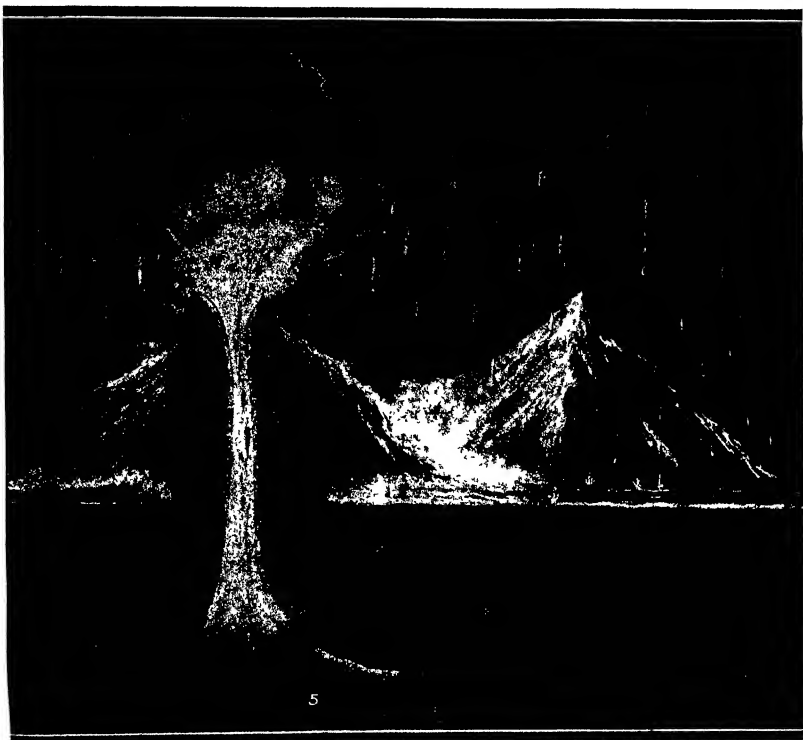
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SEVENTY-NINTH YEAR

SCIENTIFIC AMERICAN

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The mechanics of a volcano: The lava deposited by a former eruption is shown at (1), and the original strata at (2). Water sinking down to the fire reservoir (3) makes the steam of an eruption. (4) is rock which, although very hot, is not molten because of the pressure above it. At (5) the pressure has been released owing to the arching of the layer above, so the rock becomes molten, and out it spouts.—[See pages 304 and 305]

The Drama of Disputed Documents

Some of the Tests by Which the Expert Reveals the Forgery for What It Is

By Edward H. Smith

IN MAY, 1871, was begun, in the Court of Common Pleas of London, the greatest modern trial of a case involving forgery and forgery. The action had been brought for the purpose of dispossessing the trustees of Sir Alfred Tichborne, author, in favor of the plaintiff, who proclaimed himself to be the missing Roger Charles Tichborne, a rich and rightful heir to the large estates of "flie" father. The trial of this civil action and the resulting criminal prosecution of the claimant required all of three years, consumed enormous sums and brought the principals world-wide attention. It put upon the newly created records of the day one of the strange and shattering romances of crime.

Having been crowned in love through an unexpected passion for his cousin, the young heir to the baronetcy of Tichborne set out from England in 1853 for the antipodes. His ship, the "Flora," touched at Rio and put down to sea from there to return to more. Tichborne and all his mates of the voyage went down to the dark ports of the missing, and in due time the British courts in chancery determined his death and fixed the succession of the title and estates.

Only the young nobleman's mother clung with plaintive pertinacity to a belief in his survival. She had a hope, that he might have survived. She and the fates of men are never too cruel for the young maternal heart. Lady Tichborne continued to search for her lost son, mainly by asking acquaintances bound for Australia and New Zealand to seek for news of him. In 1868 a man named Charles Arden, who had established a "Fifteen Friends" office in Sydney and announced the fact in the London *Times* Collyer, was heard from Lady Tichborne and undertook to find her son. In the first months of 1869 she began to receive letters from a man who set himself up as the missing Roger and recited some of his adventures since leaving London in 1853. He told of the shipwreck, his provision of food, his eventual arrival in Australia, his trials and his wanderings. And though he made many mistakes and palpable blunders, the devoted mother declined to see any fault in him and accepted him unreservedly as her vanished son.

In response to the request the Tichborne claimant went to London in 1869 and began preparing for an action against the trustees under the old baronet's will, made when he was supposed to be dead. He spent more than five years in these preparations, not becoming his suit until 1871. How he spent this time was developed at the trial.

The claimant was in reality the son of a Wapping hatcher, by name Arthur Orton. He had gone to Australia the year after young Tichborne had set out on his fatal voyage. In the antipodes Orton had suffered many moments of reverse and impoverishment. Finally, more in jest than earnest, he had taken the name of the Tichborne heir. Later came the idea of making a grave pretension and trying to win the estate and title. Orton was a good-looking fellow of common education. The man he was trying to impersonate was a British gentleman who had been primarily educated in France and knew his French better than his English.

These heavy obstacles seemed not to daunt Orton at all. He determined to make himself act, talk and write like a gentleman. By some means he got hold of samples of the real Tichborne heir's handwriting and set himself the task of imitating it. The letters to Lady Tichborne reveal the extent of his success and the depth of his failure.

After what must have been a prolonged labor, alternating discipline and unremitting devotion, his common and practically untrained fellow was able to reproduce the handwriting of a tenderly reared and over-

sensitive young lord with almost meanly fidelity. Orton got not only the obvious peculiarities of the Tichborne handwriting but managed by some strange adaptations of mentality to achieve what must be recognized as the nervous and psychological characteristics, a fast which hardly reveals itself everywhere was a result which seemed to itself impossible. The false heir even learned to himself not do so below his own phrasing characteristic of the man into whose life and identity he was trying to substitute himself. Tichborne habitually wrote in French and translated into English when writing letters so that his opinions torned with badly disguised French idioms. These were absent from the Orton letters and it was by this deficiency that the experts of that day fastened the fraud upon him.

The man who conceived and very nearly carried to triumph this great imposture, this astounding and impudent imposture, was eventually sent to prison as a fraud and forger. Even after his conviction there were many thousands among those who had known the young Tichborne well, who persisted in the belief that Orton was the true heir and a society

verse as translations of Third Century Gaelic or the creation of a Fifteenth Century Monk. Indeed, the main trend of credulity and the main air for the shining and perilous fields of art. In common with the modern taste, it finds its way among the narrow pieces of baseness, as a result we have a more to do with false walls, bonds, legal convergences and account books. An enormous field of more or less good year by some device—tens of millions, just good. And were it not for the perfection to which the modern tradition in falsification has carried work and his art, the look of the forgers would scarcely be ten times as great. Here is where the modern contest begins between the expert in hand and typewriting and the criminal who makes this field the scene of his artifice.

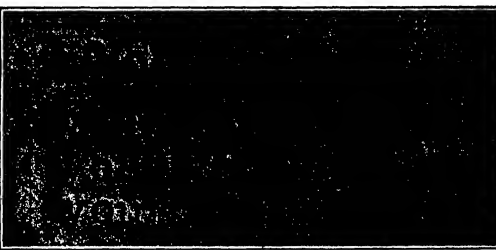
The problem of instrument falsification and detection rests fundamentally upon four materials—paper, ink, removers and restorers. Typewriters, enlarging cameras, delicate instruments for measuring loads and potholes, microscopes, straightedges, high powered microscopes, various chemicals used in analysis, requests for testing the age of inked writing and much knowledge of inks, papers, writing machines, handwriting characteristics, old manuscripts and the materials with which they were written are the necessary forces which figure in

the ink is the stuff of crime. In former times all ink was gallate of iron, a substance which turned black slowly, after shorter or longer periods. The ink of Gallate of iron is still the basis of all commercial inks now used in the United States, but today more and more auxiliary substances are being used in combination with the iron base, for the purposes of giving the ink an immediate "good color." What happens to the iron of the ink after some exposure to the air is exactly what befalls a steel blade when air and moisture strike it—oxidation. Weathering deposits a red oxide of iron on the steel. It turns the gallate of iron into black oxide, hence all iron inks oxidize. The older the ink, the older, while the auxiliary colors gradually fade. There is, however, a limit upon the process of blackening. Inks made of gallate of iron the year the oxidation is complete and no further change is observable.

This matter of the slow oxidation of commercial inks is the basis for one of the most interesting tests performed by the experts who use their sciences for the detection of criminals. As ink-writer documents submitted to them any time under eight years can be chemically treated and the date at which it was written determined within very narrow limits. This bit of the expert's technique has been found of almost limitless usefulness in connection with the doctored books so often employed in bankruptcy cases. For instance,

Recently a firm of clothing merchants failed, owing the creditors a very large sum of money for goods purchased within a month or six weeks of the bankruptcy declaration. When the case was brought before the referee it was found that only one account book remained. It covered a period of about six months previous to the debacle. All the other records had, according to the claim of the bankrupts, been either accidentally destroyed or purposely discarded after the new set of accounts had been opened.

This single account book showed disbursements of various kinds, including the payment of private loans, which brought the affairs of the concern to a sunny state. In other words, it showed that the old owner's affairs cleared the merchants of all liabilities of fraud and showed strong evidence of the reason for the failure. The referee, however, was not so easily believing that this book was doctored. The very fact that the older records could not be produced was considered ample ground for the suspicion that this one



Enlarged typewritten words taken from an anonymous letter and juxtaposed to the same words written on the suspected typewriter. Note the absolute uniformity

wrought man. Not until a good many years later, when poverty induced him to write his full confession for a London publication, was the doubt entirely cleared. This world famous case may well serve as an introduction to the subject of the evergreen contest between the falsifiers of documents and the experts in questioned instruments of every kind, surely one of the most absorbing matters of wit between the man of society and the man of crime.

Falsification of various legal instruments is, of course, extremely old. Graffiti have been found in the Nileotic papyrus which apparently admit of no interpretation more than that of fraud. The even earlier cuneiform writings on the clay of Babylon were so carefully protected by special clay envelopes, which would have had to be broken before the writing on the latter tablet could have been changed, and so elaborately provided with seals and the signatures of witnesses as to make it appear that even the men who did the oldest writing ever discovered were complaint of the forger and his methods. Classic and early Christian manuscripts, particularly those of a religious character, have notoriously been altered and defaced again and again.

They found and falsification extend to every human article of value or interest. Copied works of art, old palimpsests made in order, false signatures on pictures, fraudulent incunabula, forged autographs and spurious letters are being made and sold every day. Literary impostures are common as air, though the art has fallen upon evil ways since the day of Maupassant and his Ouelian imposture. The forger's and his heart-breaking Bowyer parchments, "recovered from the Redcliffe monument chest."

Now, alas, no one bothers to palm off beautifully done

account book had been speedily and actively prepared, just before the breaking. Such practices are, of course, very common. They are one of the principal bases of the crime of fraudulent bankruptcy which, according to the National Association of Credit Men, cost the honest wholesalers and manufacturers of the country about \$50 million a year in losses.

There was added to the suspicion in this case book of accounts. It was to be noted that all the entries in it were written in the same ink and by the same hand. Moreover, there was a slight variation in the handwriting of the bookkeeper that the work had the appearance of having been written at one sitting, it being a well understood fact that no man or woman writes precisely alike at any two times. Mood, the state of health, the weather, the position while writing, the psychological state of the writer—all these very constantly and affect the character of the writing slightly but obviously enough for the expert eye.

But suspicions are of no account in court. Unless something more tangible could be developed, this book would have to stand before the referee and the claims of the bankrupts would likely be confirmed. The book was, accordingly, taken to that veteran examiner of questioned documents, Mr. David N. Carvalho, who has been the chief American exponent of the art for fifty years and official expert of the district attorney's office for most of that long term of service. Mr. Carvalho tested the ink on the first page of the book and the ink of the last. He found that the oxidation had progressed almost equally in both samples. Also, he discovered from the degree of oxidation, that the writing had all been done within a period of ten or fifteen days and not more than 20 to 30 days before the bankruptcy. Ergo, the entries had all been written at about the same time, they had not been made on the dates indicated and were, therefore, fictitious. It was later discovered that the book had not been bought until several months after the date of the first entry. The fraud was thus established.

Palsified account books are coming to interest the handwriting technicians more and more every year, as the practice of "doctoring" accounts and falsifying entries spreads over the country.

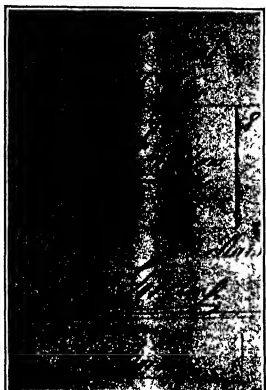
The matter of ink removals is one I discussed some months ago in connection with check forgery and alteration. It is as well, however, to repeat the fundamentals of the question here. All inks, being comparatively simple chemical compounds, may be broken down by chemical means. The exception is made of aniline inks, which have no known chemical antidotes. These inks may, however, be instantly removed with a little water or a lick of the tongue. There are acid-proof inks, and these have been largely advertised by the makers of check-writing mechanisms. But it must be noted immediately that "acid-proof" is a term of obfuscation and deception. Such inks resist the common acids well enough, but they do not resist a combination of acid and alkali, which is what everyone uses as a remover. Even the best of these inks, which can be bought in any drug or stationery store, make a swift work of such pretentious compounds.

These commercial ink removers are, as everyone knows, contained in two little bottles and ordinarily labeled No. 1 and No. 2. The first is for dissolving the order of their application. No. 1 is usually a slightly red liquid, 20 per cent solution of acetic acid. No. 2, the white or clear liquid is a 10 per cent solution of chlorate of lime or soda. The chlorate, contacting with the ink, gives off chlorine gas, a very effective bleach of almost anything. This gas immediately changes the black oxide of iron in the ink into white oxide and the writing disappears, as the bleach also takes the other colors from the writing. If the expert fingers are accustomed, of course, with stronger removers than this, but the same principle underlies them all. The fact worth remembering is that nothing is actually removed by this process. The chemicals which give the ink its black color are merely whitened and made invisible. They remain in and on the paper. Therefore, they can be seen by the expert.

The criminal, unless he is a man of technical education, usually fails to understand this and goes blithely along with his liquid inks, deluding himself that he is under the eye of the expert. A simple and easy appli-

cation of other chemicals, such as the hydro-sulfur of ammonium, to mention only one, immediately brings the "removed" writing to sight—in deep yellow lines instead of black. The white iron oxide has been turned into a sulfide and is as clearly visible as ever. This test has often been made in court, in the presence of jurors, with startling effect and usually results to the perpetrators of fraud.

It frequently happens that men who plan frauds of this kind try to anticipate the expert by causing the



Genuine signatures of the late George F. Gordon, showing that he never wrote his name in the same ink, that he used the penhold at the end and only once and the scroll underneath when he thought of it.

original documents to be written in aniline inks, which are then removed with the tongue or a wet sponge. Naturally, these inks and this form of removing leaves little or no trace and the writing cannot be restored chemically. But the expert has still a method of circumventing the crook. All paper of modern type is calendered, which means that its raised or shagreened surface is rubbed down. If a drop of water is flung down on the paper thereafter, the raised surface is touched and softened. Even if a long period of time

property. Money, goods, wealth—these are, of course, the root of his activation, but often enough the criminal must use murder as a weapon in his end. Most older readers will remember the celebrated Patrick murder trial and cannot have quite forgotten the great part played in it by the problems of forgery and handwriting.

According to the case laid down by the prosecution, Albert T. Patrick, an inconspicuous New York lawyer, came to be slightly acquainted with William Blum, Rice, a multi-millionaire capitalist who had come from Texas, and conspired with Rice's valet, Jones, to draw a large will, executed in Rice's name, in which the money was to be divided between Patrick and his wife. Patrick wrote a number of letters, which could be produced to show that Rice and Patrick were intimate friends. Patrick knew enough to have the letters and the will written on a typewriter in Rice's apartment by Jones, who did his master's secretarial work. He then had Jones study Rice's handwriting so that he might be able to forge the old millionaire's signature to the various letters.

Probably there was no original intention to murder Rice, who was 61 years old, very feeble and appeared likely to die at any moment. But extraneous events forced the conspirators to desperate action. The old man was first weakened with doses of mercerial pills and finally killed with chloroform, which was placed over his face as it now came white as sheet.

Jones, however, made two mistakes. In writing out one of the large checks made payable to Patrick, he wrote the lawyer's name "Alfrit" instead of "Albert." This blunder was found by the bank teller who refused to sign the check and led to a confrontation with Patrick. This also caused the interruption of the plan for reforming the body and thus destroying, the evidence of murder.

The second mistake made by Jones is one common to forgers of signatures on wills and other instruments. Jones had evidently not one of Rice's genuine signatures and when tracing it or copying it—probably the latter—he overlooked the fact that a man seldom writes his signature in precisely the same way and very rarely in the same ink. But all the signatures on the letters to Patrick, which were the evidence in the case, were written in the same ink and in the same hand.

The handwriting presents special problems to the conceiver and the writer. Almost everyone knows, by this time, that writing machines have their individualities like human beings. No two machines, even those of the same make and model and operated by the same person, using similar ribbons and paper, will turn out work that does not show clear distinctions, one piece from the other. Even if some of the type keys are changed, which is what the forger usually does, the machine still writes on a machine. This fact can be detected and proved. Or if all the keys are removed and new ones substituted, without the expert being able to tell the difference, there is still the rub in the rubric or the sense of mechanical imperfection.

If he does this, he can also find out where the old keys were removed and the new substituted. Thus the only safety for the criminal is to break up the machine completely and dispose of it in some sure and secret way. All these facts are more or less widely known among the sharpest of every stripe.

What is much less familiar to the public, and the crook is the fact that typewriters have the services and psychological, as well as its physical peculiarities. The fact that a piece of typing has been done by a person who uses the left hand is almost as great an aid, whether the writer is calm or excited, or so on. Each operator uses a machine in a different way, and individually uses various keys for special purposes, etc. Mr. C. I. West, the veteran investigator of the National Association of Credit Men, has used one of the most celebrated of credit swindlers through peculiarities in typing. This man was in the habit of opening women's wear stores and shops about small towns and

(Continued on page 803)

The last clause of the apocryphal will of George F. Gordon, showing the spurious signature with the penhold at the end and the uncertain, obviously copied scroll underneath

elapses, this blunder remains. The expert finds evidence of this type by submitting the entire writing to the fumes of iodine. Wherever a paper has been so exposed the iodine fumes cause it to turn blue and to begin to show the previously invisible pen wounds or cuts in the paper. Again, such line spots are then lightly dusted with lamp black and the original writing may then be clearly seen.

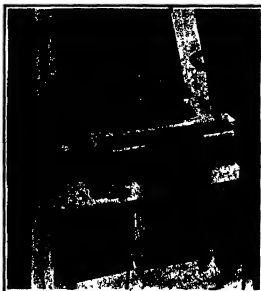
It must not be supposed that the criminal who falsifies handwriting confines himself to offences against

Earthquakes and Volcanoes

The Mechanics of These Titanic Subterranean Forces and Their Destructive Careers

By Edgar W. Woolard

Division of Seismological Investigation, U. S. Weather Bureau



Largest seismograph in this country, installed in New York City. This is a close-up view of one of the recording members.

VOLCANISM and earthquakes afford spectacular and impressive manifestations of the titanic subterranean forces which are still at work on the fashioning of our globe. The cataclysms and upheavals accompanying their operations have occasioned the most terrible disasters which have befallen mankind. Catastrophe after catastrophe of this nature has marked the course of history, but never, perhaps, one so great as that which at noon on September 1 I felt in ruins two of the principal cities of Japan and took a toll of about 200,000 lives. And as the Japanese people, like all peoples be fore them similarly stricken, turn quickly to the work of reconstruction, we wonder at the exhibition of once of man's nobleness and his greatness in the face of these appalling forces of nature.

Mastery over the effects of these natural forces comes only through a thorough understanding of their operations. Unfortunately, our views concerning the ultimate causes of volcanic and seismic phenomena are distinctly less confident than were those of previous generations. The "united frontier" of the earth and the deep "internal fire"—supposed heretofore from that far-off age when the earth was born from the primal nebulae—as the source of internal heat and of volcanic outbreaks have been banished from textbooks of geology, and their place has not been filled to complete satisfaction. Again, the simple conviction of a cooling and therefore shrinking interior, over which the crust of the earth continues to be crumpled and wrinkled as the earth continues in contraction, has been found inadequate fully to explain the origin of the forces which build mountains and cause the solid earth to tremble.

General Structure of the Earth

Several lines of evidence point to the fact that the earth is solid through out, and about as rigid as steel. On the other hand, observations in mines and deep borings leave no doubt but that at comparatively moderate depths within the earth the temperature must exceed the melting points of all known substances. However, most substances, and probably all ordinary rocks, expand in passing from the solid to the liquid condition. For this reason liquefaction is opposed by pressure, and a much higher temperature is necessary to melt a rock subjected to great pressure. Hence the tremendous and ever-increasing pressure within the earth keep the material in the solid state. At the same time, these very pressures now overcome the expanding strength of any known substance.

At a depth of from 12 to 15 miles the rocks must be reduced to a state where they are under stress, in part or far, instead of fracturing or crumbling. In short, the pressures and temperatures within the earth reduce the rocks to a state like that of the solids or the liquids with which we are familiar.

This part of the earth grades slowly into the outer brittle shell, where an increasing stress will in time

result in the fracturing of the rock and the bodily displacement of blocks of the earth's crust along the break, or fault, as the geologists call it. The stresses are known to tear upon the crust of the earth have been, and are still being, relieved by constant slow movements up and down, by warping, folding, faulting and dislocation, of the rocks of the crust, and by continual readjustments within the earth. Rock strata, the structure and contents of which prove to have been originally horizontal sheets of sediments deposited at the bottom of the ocean, are now found at all elevations up to the tops of high mountains, sharply folded, and traversed by extensive faults, often hundreds of miles in length, along some of which thousands of feet of slippage has taken place. Great belts of weakness have been developed in the crust along which the major deformations have taken place.

Volcanic and Seismic Phenomena

Earthquakes and volcanoes are inseparable accompaniments of the above processes of earth deformation.

The immediate character of earthquakes has long been established as a form of undulatory motion in the more or less elastic rocky crust of the earth, originated by some sudden impulse or disturbance in the substance of the earth, much as a bowl of jelly might be set in vibration by a smart tap on the side of the vessel. In many cases, as in the California earthquake of 1906, the shock is accompanied by violent fractures and displacements of the solid rock, the disturbance reaches its climax close by the fracture. In other cases no actual faulting is visible at the surface. The whole of the slipping having taken place some miles below the surface. However, we have here only the beginning of the story, for we need to know how the fracture of the earth gives rise to the quake, and this problem has not yet been fully solved.

Intuitively, the investigation of volcanism has raised a wide range of problems, most of which still await solution. Just why volcanoes erupt, we do not know. The average density of lava differs little from that of the surface rocks, indicating that such material does not come from a great depth. It is in the various movements and deformations of the crust, the pressure should be relieved at some point within, melting would doubtless occur, and a body of molten magma be formed, but no satisfactory reason for its ascension can be assigned. The generation of steam appears to have much to do with volcanic eruptions, and the fact that almost all eruptive volcanoes are situated in, or relatively near, the sea, or near lakes, has led some to believe in a sufficient connection between volcanic activity and surface

epical existing mountain chains were born. They occur in great bands, marking the lines of weakness in the crust, and generally following the line of elevation which bound the Pacific oceanic land—regions of mountain, or in some cases still continuing, mountain growth. The rocks are held by friction and pressure, under increasing stress until they yield. Slipping suddenly, they accumulate an elastic shock or jar to the crust of the earth, and vibrations spread out in all directions, with velocities of several miles per second. The vibratory motions, together with the sudden displacements and buckling of the crust, may cause general destruction over a wide area. Alarming sounds issue from the bowels of the earth, and if the quake occurs near or underneath the coast, it is followed by a series of great sea waves (popularly misnamed "tidal waves") called tsunamis by the Japanese, which travel across the ocean at the rate of 300 to 500 miles an hour. A strong quake is invariably followed by a great number—usually hundreds—of weaker shocks.

Earthquakes are not always due to a single fracture or close-set group of fractures, they sometimes have very complex origins. Oldham has concluded that the faulting to which the destructive shocks are due is the secondary result of an extensive readjustment of some kind to 80 or 100 miles below the surface. It is possible that minor factors may contribute to the determination of the exact moment at which a stress near the breaking point will be relieved by fracture. Thus Omori has found an apparent connection between volcanic and earthquake frequency in northern Japan, and several investigators have found that volcanic eruptions, earthquakes and barometric pressure a quake may be set off by an additional weight of air and water on the land surface.

The permanent changes of position of the ground in violent quakes take place simultaneously in opposite directions on either side of the fault, and decrease in magnitude with increasing distance from the break until they cease to be measurable at a distance of several miles. The displacements, often amounting to 10 or 20 feet or more, may be horizontal, vertical, or both. This movement on opposite sides of the fracture in opposite directions is characteristic of the disruption of materials under stress, and quite in accord with dynamical principles.

When shocks are frequent and slight in a section, the stress is constantly being relieved, and there is less danger of a heavy quake, where quiet has reigned for a long time, the danger of a heavy quake is likely to be severe.

Earthquakes due to disturbances in connection with volcanic operations also occur, but, while often severe locally, seldom are noticeable more than a few miles from their origins. Tremors occasioned by the collapse of underground caverns are likewise local and unimportant. The tectonic quakes, however, i. e., those due to faulting of the rocks in the interior of the earth, along breaks already formed, may completely devastate hundreds of square miles of territory, and may cause the disruption of mountains through the entire globe.

The vibrations or elastic waves which spread out through the globe from the focus, or seat of the disturbance, may be recorded by means of instruments known as seismographs. (The measurement of the great intensity of the ground near the origin of a quake is beyond the capacity of any instrument.) The seismograph consists of a heavy mass of metal arranged in the form of either a horizontal or a vertical pendulum, which is suspended by a fine wire, and is free to rotate about the point of suspension. A pen or stylus is so connected as to trace on a revolving drum the motion of the earth when the latter is shaken. A pen or stylus is so connected as to trace on a revolving drum the motion of the earth when the latter is shaken. A pen or stylus is so connected as to trace on a revolving drum the motion of the earth when the latter is shaken. A pen or stylus is so connected as to trace on a revolving drum the motion of the earth when the latter is shaken.

Two principal sets of earth vibrations are generated



Bird's-eye view of Japan, showing how the islands are formed by the tops of mountains which rise out of the sea.

water. But it is now generally believed that the stress is produced in the interior of the earth, and that the rocks are always present in the depths of the earth.

Earthquakes

The seismic regions of the earth are those in which extensive layers of rock of great thickness have been internally folded, dislocated and elevated when the pressure

during an earthquake. One set travels round the earth in the crust, while the other goes through the interior of the earth; the latter set, again, is compounded of two species of vibrations superposed—one longitudinal (like sound waves in air), the other transverse (like light waves in the ether). The three kinds start out from the focus simultaneously, of course, but those which travel through the earth are registered first at a distant point, though the other set are registered first at a distant point, not only because they have not so far to travel, but also because they are propagated at a much greater speed. Furthermore, the longitudinal vibrations (precise waves, or first preliminaries, as they are called) travel faster than the transverse (secondary waves, or second preliminaries). Hence the three kinds of waves arrive at a distant point each at a different instant, and each in mass waves of a different shape on the seismograph record.

A destructive quake is usually registered by seismographs all over the world, at a distant point, the seismograph often continues to record small vibrations for two or three hours. The study of the records of numerous quakes has made it possible, by noting the intervals between the arrival of the different types of waves, to draw curves showing the time taken by the various waves to travel given distances, and to construct tables from which the distance of the region lying above the focus (the epicenter) can be determined for any point at which a seismograph has been obtained. At most, only a guess can be made as to the actual location of the quake, however, unless the distances from three stations have been determined. Then it is a simple problem to locate the quake exactly by drawing circles on a globe with three distances as radii and the stations as centers, and noting where the three circles intersect.

An earthquake is felt in some part of the world on an average of 4000 times yearly. In the United States alone, a hundred or more occur each year. Many tremors, occurring over small areas, are undeniably misnamed, and others, too faint to be sensible, are registered by the seismographs. Our globe is trembling everywhere practically all the time. Milne estimates the total annual amount of energy from all sources to be 90,000 quakes. Fortunately, the great majority of these are feeble and harmless, or else occur under the sea or in thinly populated districts. According to Milne, only 4151 destructive quakes occurred between T. A. D. and 1900.

Japanese Earthquakes

The most unstable region of the earth at the present time is that along the western margin of the Pacific. It was in Japan, probably the most seismic region of the globe, that seismology as a science was first developed. For years ago, through the pioneer work of the British scientists J. Milne, J. A. Kving and T. Gray, the earthquakes of the Japanese Empire have been studied more carefully than those of any other country.

The Japanese islands are arranged in the form of a festoon, with its convex facing the Pacific Ocean, and as in similar groups of islands and in mountain-chains of the same form, the convex side slopes more steeply than the other. The Japan Sea to the west is shallow, but on the Pacific side, between the Japan coast and the Kurile Islands, the ground plunges down into the great Tuscara trench to a depth of nearly 27,000 feet within 10 to 240 miles of the coast. This is the source of many of the great quakes of Japan follow a law which is general in such cases; they are more numerous and violent on this steep slope. During the 51 years 1868-1900, there were every strong quake originating on the concave side of the islands, there were 16 on the Pacific side.

Earth tremors are a matter of daily routine to the Japanese people, 12,770 having been recorded in the 51 years 1868-1900, while from 1900 to 1907 the average

annual number was 1005. However, from 1903 to 1908, only 108 destructive quakes visited the country—one on an average of every 2 1/2 years—and only a few of these rank as outstanding disasters. The quake of 1708 is reported to have cost 200,000 lives. In the Min-chang disaster of 1891, 7000 perished. Obviously as Japan has suffered from earthquakes and their effects in the past, the devastating shock of September 1 probably surpasses all previous disasters, although we have as yet only incomplete reports and no scientific observations. The Osaka observatory places the epicenter in the San Peninsula. The shock was violently destructive over an area extending 100 miles from north to south and 120 miles from east to west, and having a population of about 7,000,000.

Other Great Earthquakes

Space will not permit of even an enumeration of all the great earthquakes of the past, but we may mention



Active and recently extinct volcanoes of the world. The active volcanoes are shown as dots, while the recently extinct volcanoes are shown as crosses.

a few of the more notable are reported in connection with some great quakes. Thus, in India, 1747, 80,000 are said to have perished, and again in 868 in India, 180,000. The greatest disaster of modern times, next to the present one, was the Meissen-Bagdad quake of 1908, with a loss of 100,000 lives. The most stupendous shocks on record are the Asian quakes. In India, 1867, destructive over 150,000 square miles and distinctly felt over one and three-quarters millions of square miles, and the Kan su quake in China, December 1920. The former was not so violently destructive of life and property, but in the latter the estimates of deaths run from 40,000 to 180,000, although it was occurred in a remote region, from which news was only weeks in reaching it at treated little attention. In the famous quake of 1887, felt over Mexico, Arizona, and New Mexico, an uplift of 20 feet was reported along the base of a whole mountain range, but the region disturbed was only slightly inhabited. The great Alaskan quakes of 1868, in which a vertical displacement of more than 60 feet occurred, passed almost without notice for some time.

More famous are the Neapolitan quake of 1857, the extensive earthquake of which by Robert Mallet was the first great scientific contribution to what is now the science of seismology, the Lisbon quake of 1755, in which 40,000 perished, and the Aveasano quake of 1915, in Italy, in which the ratio of deaths to population was the highest ever recorded, 67 per cent of the people of Capelle having been killed. Little is also noted for some disastrous quakes, the most having been in November, 1922.

A series of tremendous shocks rocked nearly the whole of the then settled portion of the United States for many months in 1811-12. The subsequent effects of this New Madrid earthquake, as it has come to be called, are still plainly visible in the Mississippi valley, and aftershocks are still continuing. Charleston S. C., quake of 1844 was relatively mild, but affected a very large area. The San Francisco earthquake and fire of 1906 is famous for the great property damage, but the deaths were very few.

The entire Full Line of the Atlantic seaboard is a potential mass of earthquakes.

Prediction of Earthquakes

Possibly we shall never be able to keep a record of the elastic vibrations of the earth's crust along danger lines, and thereby forecast a shock as we now do the coming storm. But that ability if it came at all must await patient investigations over many years in the future.

Geodetic surveys in California have indicated an upward creep of the crust relative to the Sierra Nevada, in certain regions of about three feet in ten years. Prof. A. C. Lawson of the University of California, cautions this slow displacement to be a strain ever which accumulates until relief is effected by a sudden slip or a rupture, and he believes that it may be the cause of the great earthquake when the strains that are indicated by these movements will be released and cause a quake, possibly with a loss of many lives.

On the basis of the number of quakes in the years immediately preceding, Quake in 1922 forecast the occurrence of severe shocks in Japan, 1924, 1926, and 1928. Similar general indications may sometimes be obtained from a study of the migration of quakes in a recent period. A great quake follows the stress in its neighborhood, and when next the stress finds relief it is likely to be at a more or less distant point along the belt. This is illustrated by the series of shocks along the west coast of the American continent from 1900 to 1922, as follows: Alaska, Sept. 4 and 11, 1900, and Oct. 6, 1900. Mexico, Guatemala, and other parts of Central America, Jan. 20, 1900 and April 19 and Sept. 25, 1902. In California, the Mendocino, Eureka, Jan. 31, 1906. California, April 18, 1906, and Valparaiso, Chile, March 17, 1906, Mexico, April 19, 1907 and Nov. 19, 1907.

The most effective means of minimizing the danger from earthquakes is through extensive investigation of the location and activity of faults, and the study of the effects of earth shocks on buildings and structures, together with the evolution of an enlightened public opinion by the wide dissemination of scientific information. The element of danger will not then be grossly exaggerated by ignorance and negligence.

Except where the accompanying fire is so great that the loss of life is largely due to the shaking down of poorly constructed buildings. This can be prevented by a knowledge of stronger materials and suitable types of construction. Only in Japan, however, has such knowledge been extensively applied. The native houses there are built to allow for earth tremors, being

(Continued on page 370)

Earthquake regions of the Eastern Hemisphere, shown in black.

Our Abrams Investigation—II

A Test to Determine the Accuracy of the Electronic Reactions Diagnosis

As reported by Austin C. Lescarboua

Managing Editor, SCIENTIFIC AMERICAN, Secretary to the Scientific American Abrams Investigation Committee

DR. A. HEST test of the electronic reactions method of diagnosis took place on Saturday, September 15, in the laboratory of an Abrams practitioner in New York City. At the invitation of this practitioner, whom we shall refer to as Dr. X, in the report which we brought to the laboratory a number of vials containing pure germ cultures for the purpose of determining the accuracy and dispatch with which he could identify their contents. This seemed a simple yet convincing test, so we all agreed.

The laboratory, in this instance, is located on the ground floor of a typical high-grade apartment house in one of New York's exclusive neighborhoods. It is here that Dr. X carries on his diagnosis, work, while in other rooms of the apartment he has a vast array of electrical and mechanical and luminous devices for the treatment of patients. The laboratory proper is by no means large or electrical, indeed, it fairly bristles with various devices and wires and lights. It might well be taken for an electrical or physical laboratory, rather than a doctor's consultation office. First of all, there are large metal plates on the floor, one of which, we are told, have to do with a chromatographic method of diagnosis which does not concern us in our present investigation. Finally, there are several pieces of apparatus on the conventional white-topped table, which, at first sight, might seem nothing so much as electrical measuring instruments or, better still, radio equipment.

But in spite of all this equipment the main element in the electronic reactions method of diagnosis is the human reagent. Dr. Albert Abrams of San Francisco, the founder of this new medical cult which has attracted nationwide attention, discovered a device or so ago that the human body and blood had certain radio-active properties. Based on these early discoveries, Dr. Abrams has worked out a method of diagnosis whereby a healthy human being, placed in a so-called electronic circuit with a sample of blood to be tested, and the inductive reactions are obtained from a human being, known as the "reagent," at the hands of the skilled Abrams diagnostician. The reactions are generally developed by the portions of the reagent's body—the abdomen is the area usually selected, although for specific diagnostic other areas are used. Preceding is accomplished passing the extended and rigid palm of the left hand over the abdomen of the reagent, and tapping the middle finger of the left hand with the middle finger of the right hand. The right hand finger is provided with an ordinary cylindrical tinplate filled with beeswax and small shot, so as to obtain better drumming of the left hand. Normally, the percuting of the abdomen produces a characteristic hollow sound over an area which persists upward to a line on a level with the lower ribs. When the extended hand passes above this line, there is a decided change in the sound produced by percuting. The hollow sound now becomes a dull thud. The right hand finger of the reagent having been determined, the reagent is marked with a black cross to indicate the normal line.

So much for the normal reaction. Now, however, the reagent is connected with the electronic circuit and a sample of blood or other representative matter from a patient and wire the electronic circuit. The patient for various "rises" of vibration by means of a bank of switches the electronic circuit remains at the normal line or drops down some distance.

Let us go through a typical diagnosis, as we make the workings of the electronic circuit clear to go ahead with the business of the first test. We begin with the sample of blood or other matter is wiped, as usual, with an ordinary clean cloth. In the next, an ultimate electronic electronic impression is in the first to assume that any sample, in the course of ordinary

handling, must pick up its due share of these electronic impressions which we are given to understand permeate everything and everywhere. But why the electronic values of the patient, with all their definite standings and varying degrees of strength, we go to make the diagnosis so critical as compared with orthodox medical practices, are not also wiped out or at least seriously impaired as the result of the magnetic wiring, we do not profess to know. We are still woefully ignorant on this point.

At any rate, the extraneous electronic impressions are wiped out and the sample is placed in the so-called dynamometer, which has also been wired with the hand-wiring, however, in order to wipe out the electronic impressions that may have stayed behind from previous samples. The patient is then placed at the bottom of which are two electrodes whose ends are separated by a small air space. These two electrodes are generally connected together, and the single lead wire goes to supplying device and to the array of other instruments. The patient is then placed in the electronic circuit with the under side of which has a metal plate connected with

also array of other things with terrifying names and liberal change—about for a long while back, without even suspecting the fact, until he was confronted with his electronic reactions diagnosis.

From "rises" of the electronic circuit to "rises 57," which represents congenital syphilis. If the reagent reacts to that rise, then the second bank of switches is manipulated to restore the normal of dullness, and a reading in ohms is taken for congenital syphilis. And so the diagnostician goes down through a long list of "rises" which stand for so many ailments and diseases and afflictions. This is a set routine, of course, such as acquired syphilis, congenital syphilis, tuberculosis, gonorrhea, streptococcus, colon septicaemia, typhoid, malaria, influenza, and so on. Incidentally, we might mention in passing that lack of the person who escapes without a trace or more of the electronic circuit in an electronic reactions diagnosis. Hence there need be no hard feelings we're all pretty much allies, electronically speaking.

The result of an electronic reactions diagnosis is a list of "rises," their corresponding medical terms, and their action in ohms. Following such a diagnosis, the patient may be treated, if he so desires, and "cleared" of the patient's list of his various troubles. Some "rises" clear rapidly, while others require some length of time. When all "rises" of a patient fail to give a reaction through the reagent, then that patient is considered cured, or cured.

There is one thing to be noted in this diagnosis by proxy, so to say, in that the patient need not be present. There is no reason why the patient should not be present, that is more spectacular—or more unbelievable. Here we have a means of diagnosing diseases in the absence of the patient; indeed, someone has promised to diagnose Kryptan mummies in order to determine the disease which prevailed in the distant past! Skilled Abrams practitioners will assure you that they can take a specimen of your handwriting and not only tell you all about your medical history—past, present and future—but also your racial strains, religion and other choice bits of private information.

Coming back to Dr. X and his laboratory, we start in with the patient, whom we shall call "George" for short. George is a handsome lad of about 18 years of age. He has a remarkable physique, which was all the more in evidence when the editorial "we" disrobed sufficiently to serve as the reagent in previous informal tests. In the day of our present test George appeared to be in the pink of condition. Dr. X asked George if he had had any recent work of his hand, and upon receiving a negative reply he ordered George to do so. Then George did a few calligraphic—erasing his arms, working with a pen, and so on—just like a first writer getting ready for action.

Being curious as regards the mechanical side of this test, we studied the apparatus in the laboratory, which is the floorless floor covering. They did not appear to be connected at first glance, and this aroused our suspicion. We tried to get the ground wires connected, but the water pipes, which were to be coated with paint. Here, we thought, was a weak point; but further examination disclosed the mechanical ground wiring running in the walls and making a direct connection with the floor.

We were entirely directed in this direction when George

RESULTS OF THE ELECTRONIC REACTIONS DIAGNOSIS

The pure germ cultures used in this diagnostic test were as follows:

Tube No. 1—Typhoid. No. 2—Pneumococcus. No. 3—Colon Septicaemia. No. 4—Tetanus. No. 5—Tuberculosis. No. 6—Diphtheria. The tubes were handed to the electronic reactions diagnosis carrying the corresponding numbers, and the findings in ohms are given below.

	No 1	No 2	No 3	No 4	No 5	No 6
Acquired Syphilis	55	65				
Congenital Syphilis	146	49	27	+	+	148
Tuberculosis	7	6	7	+	+	8
Gonorrheal Infection	88	89	16	+	+	200+
Streptococcus (Pneumococcus)	183	89	49	+	+	87
Malaria	59	17	17	89	+	28
Typhoid	+	+	+	+	+	+
Influenza	210+	84	46	82	+	82
Colon Septicaemia	68	9	22	+	+	69
Diphtheria	Not tested.	3	Not tested.			
Tetanus	Not tested.					

the other apparatus, consisting of multi-contact switches.

So far, so good. The reagent, stripped from just below the waist, up, takes his place in front of the diagnostician, standing on a pair of grounded zinc plates. The diagnostician is ready to begin work. He determines the normal line of dullness, puts a mark on the reagent's abdomen, and adjusts the little switches of the diagnostic machine for the first "rises" of vibration, which is 55, designated to permit only positive electronic, or whatever they may be, to filter through to the reagent.

The diagnostician now perceives, and notes if the area of dullness has dropped down below normal. If it has not, the patient is "clean" on that score. If it has, then he manipulates a second bank of switches in order to obtain a quantitative reading. The second bank, like the first, is arranged with switch points in suitable multiples representing ohms or resistance introduced into the electronic circuit. The diagnostician adjusts the switches of the second bank until the area of dullness is 55, designated to permit only positive electronic, or whatever they may be, to filter through to the reagent.

This the diagnostician obtains not only a "rise," which in this case is 55, which, according to the Abrams chart of "rises," represents acquired syphilis, but also a quantitative reading in ohms, such as 5 ohms, 15 ohms, 15 ohms, and so on. The "ohms," of course, represent the degree of the ailment or affliction. We are told that the ohms do not run outside of the normal line. Thus in tuberculosis 5 ohms is sufficiently serious to require treatment, while in malaria one can be quite content with 17 ohms. The ohms of these "rises" were carrying 17 ohms of malaria—not to mention a

Our Point of View

Naval Day

BECAUSE of the inevitable decline of interest in the Army and Navy which manifests itself at the close of a great war, the setting apart of Naval Day for the year 1929, on which the country is asked to give thoughtful attention to naval affairs, is altogether commendable.

Speaking in favor of the institution of Naval Day, and having in mind no doubt the pernicious propaganda which aims at the immediate abolition of all armaments, President Coolidge recently said: "Our country has undertaken as its proper contribution to ameliorating the burdens of armament in the world, to place certain strict limits on our naval establishment. In view of this, it becomes desirable that the highest efficiency in men and material be maintained." To the same purpose, Acting Secretary Theodore Roosevelt reminds us that "behind the protection of the Navy our people are able to carry on their lives, develop their ideas and live in the righteous peace we so earnestly desire. It is the right arm of our State Department."

Of the misleading statements made by those who would emancipate, if not altogether destroy, our Navy none is more false and unjust than that which describes the Navy as a symbol of war and its officers and men as the advocates of war. As a matter of fact, from admiral down to enlisted man, there are no citizens who are more united in the earnest desire for peace. They know what war means. President Kelly of the Navy League is well within the truth when he states that no men are more truly pacific than our Army and Navy men—"our own brothers and sons, who realize more keenly than others the horrors of war, and seek only the strength that will maintain peace—the peace of honor and justice which is the only peace America should ever tolerate."

When the history of the stupendous evils of the war and the past war period comes to be written and they can be judged in their true proportion, we believe that the gathering around the table of the five leading naval powers at Washington in frame the Treaty of limitation, will be recognized as perhaps the greatest single contribution of the United States to the permanent peace of mankind. That treaty has never been ratified by all the powers concerned, and they, with us, are at present engaged in breaking up the superfluous material of over-developed navies.

Let no one regret this destruction, for this superfluous armament was the child of suspicion, fear and international hatred. The fleets as reduced by the treaty are no more nor less than the international police of the high seas. It is the duty of the American people to maintain its present Navy, which is presently a preponderance of the power, at its highest possible level of efficiency, and give to it at all times loyal and patriotic support.

"ZR-1" Sails Over New York

OUR FIRST sight of "ZR-1" came from the observation platform of the Woolworth Tower, as she reached New York City exactly at the hour predicted. It was in mid-September, and a faint haze, suggestive of Indian Summer days to come later, softened the outlines of the city below. Precisely at 11:30, out of the air came the distant drone of the ship's motors, and lo! above the Statue of Liberty there became visible through the haze what looked for all the world like a gigantic silver bubble, which grew in size until the great ship swung to port and revealed the whole 680 feet of her truly beautiful form to view. With her six motors throttled down to half speed and the national flag snapping at her stern, she swept majestically by as she laid her course for the Hudson River.

Apart from the beauty of the spectacle (and a silenced dirigible, when seen under such conditions, is an undeniably object of interest), what strikes imagination was that of the stability and perfect control of the

vast ship, which, be it remembered, in spite of the light and fragile materials of its construction, weighs no less than thirty-seven American tons. Throughout her run, her juncos up and down the length of Manhattan Island, she traveled for the most part on a level keel. Occasionally, vertical and horizontal changes were made under an excellent and very gradually. Finally, in these early trials her commander is not going to subject "ZR-1" to the severe bending stresses, due to a sudden and extreme shift of the helm, which cramped up the striders of "Z-1" and brought about the fatal disaster at Haiti, England.

During her last run, before heading for Philadelphia and home, she passed directly over the Woolworth Tower twice as far above our vantage point as we were above the street below. To stand on a man-made structure that soared 750 feet above the earth and watch that huge thing, with such other and with the commander-in-chief, they will render impossible any surprise attack upon our shores.

It is no empty boast to claim that "ZR-1" is the finest ship of the world, or of any other, type that has ever been built. For so she should be, since within her has been incorporated all the experience of the German, who originated the Zeppelin, and of the British, who carried on dirigible construction in the years succeeding the war and made a successful novel voyage from England to America and back.

But over and above this, the new design has engaged the best talent of our very able corps of naval constructors. Not only have the stresses (far more complicated in a ship of the air than in a ship of the sea) been made the subject of exhaustive study, but every member that was built into the framework was first tested in the naval aircraft factory at Philadelphia. Finally, and as a result of all, the use of the most dangerous hydrogen has been abandoned and "ZR-1" is filled solely with non-explosive helium. Hence she is the first ship to be rendered immune to the flaming bullets of attacking airplanes.

Pandora's Chest Modernized

OUR FAMILIARITY with the wonders of radio broadcasting may not exactly breed contempt, but at least it takes away the romance of the thing. As a fairy tale, radio broadcasting would fare quite well; indeed, the present-day receiving set in the home, bringing to the household the music and news and talks from the four corners of the globe, might well fill the rôle of the famed Pandora's chest with its never-ending flow of beautiful contents. As a reality, however, radio has its romance as it enters in practicability and popularity. But, then, this is a practical age!

Pandora's chest—that is the keynote of the radio development. When radio first came into the household as the result of broadcasting, it had a distinct laboratory touch. There were numerous handies to adjust, storage batteries to recharge, dry batteries and connections to switch after and a mass of wires connecting the various scattered components. Frankly, as a living room furnishing the radio set was relegated to the back of decorative schemes, and more than one fastidious housewife stood firm against even a reasonable claim that the radio set stay in some far-off corner of the house, there to be enjoyed but not seen.

But radio broadcasting has brought about a change in radio engineering and designing of apparatus. It

soon dawned on radio engineers that the receiving apparatus, as used in the average household, is only the means and not the end. It is the means for receiving the broadcast programs; in truth, the average person would as soon do away with the receiving set and use a plain tin horn, if such a credibly would give the desired result. The modern radio, then, has more and more simplicity combined with greater and still greater efficiency.

The answer to all this is now evident. Radio engineers have done remarkably well—almost unbelievably well. They have eliminated the troublesome storage battery, they have developed new types of vacuum tubes the filaments of which require a minimum of current, which can be supplied by ordinary dry cells, they have worked out simple circuits which reduce the controls to a minimum while giving excellent results, they have developed good loud-speakers, which are small, efficient, necessary of head-phones, they have designed attractive cabinets which now contain every component of a radio set, including the batteries. The result is the compact, attractive cabinet which is invading the sacred premises known as the living room. The highest development of this kind is in the form of cabinets resembling photographs, containing everything, including the loud-speaker horn.

So, at last, we have the modernized version of Pandora's chest. In the corner of our living room we have a small, attractive cabinet, blending in with the general scheme of things. We step up to the cabinet, turn a small knob to light the filaments of the concealed tubes, and another knob to search for stations. We hear a faint whistle. We move the knob more cautiously, dissolving the whistle into the strains of an orchestra. We move a second knob, which gradually transforms the orchestra strains into the desired volume of sound is obtained from the loud-speaker horn. For quite a while we listen to the various selections of this orchestra, coming from the roof garden of a renowned hotel 20 miles away. At 10 o'clock we tune in for the ringtone in a neighboring city, where a much-louded bell is being staged between famous heavy-weights. We hear the faint blip, blow by blow, as well as the gong, the cheers of the throng, the whistle of the timekeeper, and other noises that go with pugilistic activities. The battle is soon over, and we know the results several hours before the arena is re-animated as the winner is crowned. By now it is 11 o'clock, the local broadcasting stations have "signed off" for the night. Again we explore with the tuning handle—a whistle—and then we hear the faint, but distinct, strains of the orchestra, the announcer's voice. We learn that the jazz music is from a city half-way across the continent!

So Pandora's chest of Babel is now, truly by the Pandora's chest of fact. Once more, truce is strange than fiction.

A Poorly Housed Business Institution

THE HIGHER is nothing akin to the success of a business institution more than poorly housing it. This is true of governmental bureaus and institutions as well as of private concerns. The United States Patent Office is one of the few offices in which the earnings are relatively large as compared to the expense, ranking in this respect with the Post-office Department, Customs Bureau, The Internal Revenue and similar institutions. It is one of our great Government. The Patent Office has a somewhat unique arrangement in that it runs what might be termed a large retail store, the stock of which is limited as to variety, but is one of our very profitable sources of profit. The branch of the Patent Office that is devoted to the sale of soft patent copies of patents. Millions and millions of soft copies of patents are stored in the United States Patent Office for sale at very reasonable prices. The number handled each day would gladden the heart of a merchant prince. Owing to inadequate facilities these copies are now sold on the floor of the Patent Office. In hallways here, in corridors there, and in walls

Our Point of View

rooms extending out under the foot pavements of the city and in the tier after tiering so high as to necessitate ladders to reach the upper row. Many of them are on wooden shaves that increase the danger from fire and the spreading of the copies all over a large building necessitates the copy pullers travelling mile after mile each day in pulling the copies. A limited quantity of metal racks have been provided but these do not begin to supply the reasonable demand. The copies are so distributed that it is difficult to promptly secure a desired copy, and this is a large measure before the sale, as instead of ordering copies the person desiring them will take the trouble to inspect the records of the Patent Office to avoid delay. Much of this could be avoided by providing suitable metal racks for all the copies and also by providing for the arrangement of the copies in compact form and in close proximity so that the pulling of the copies will be greatly facilitated.

The rooms housing the various Examiner's divisions are all seriously crowded, thus interfering with the work and adding delays where the delay is now of great inconvenience to the public, and some divisions are housed in the corridors where they are partitioned off by the cases and subject to all the interruptions and disturbances incident to those traversing the corridors.

The copies of foreign patents issued since 1914 were greatly delayed in delivery by the War, and when finally delivered to the United States Patent Office were delivered in such bulk that space is not available for the proper classification and the Patent Office is unable sufficient to permit the proper classification of these copies, so that searches among the foreign patents are necessarily incomplete and extremely unsatisfactory.

All of the foregoing conditions of the Patent Office are conveniently housed and well offered, if the recommendations in the Commissioner's report for the year ending December 31, 1932 had been carried out by Congress. As the Patent Office is really a business institution, serving the public and being well paid by the public for the service rendered, there appears nothing unreasonable in the desire and expectation that Congress will afford suitable facilities for the proper transaction of business which in itself is profitable to the Government.

The Navy's Contribution to Industry

THE present agitation in favor of the complete abolition of armaments and, therefore, of our splendid Navy, is, unfortunately, uninformed, and generally springs out of an abysmal ignorance of the subject. To be consistent, the advocate of complete disarmament should also advocate the closing of those police forces which enable city dwellers to work and sleep in security.

In a recent issue, we touched upon this subject, and laid special emphasis on the role of the Navy as a training school for our young men in habits of orderliness and discipline, and in respect for constitutional authority. We now draw attention to the fact, so generally overlooked or ignored, that the great merchant fleet which fetches and carries the products of industry is equally indebted to the Navy for the great technical improvements which have helped to raise it to its present standard of speed, comfort, reliability and high operating economy.

Take the fundamental question of ship propulsion. Less than 20 years ago the cumbersome reciprocating engine was in exclusive vogue for the field, both as to freight and passenger ships, and it is largely to the creative initiative and support of naval engineers, both here and abroad, that the world owes the more, positive improvements which have given us, first, the direct connected turbine, then the geared turbine, and lately the steam-electric drive, which has proved itself satisfactory to our Navy and the latest battleships are equipped exclusively with this system. To the navies of the world, also, we are indebted for much experimental work in the development of the Diesel

marine engine, which in economy of weight, space and consumption stands so far in the lead as to be in a class by itself.

But, although its work in developing improved means of propulsion is its greatest contribution, we must not forget that there are hundreds of other directions in which this great "laboratory of experimentation," as the Navy has justly been termed, has made generous contributions to industry. The electrically operated winches, pumps, ventilating fans, and various other auxiliaries which are now being introduced aboard merchant vessels, have been in use for over fifteen years in our Navy. Furthermore, the Navy was a pioneer in the use of super-heated steam, and the Merchant Marine is indebted to it for research work in developing alloys of various kinds for condenser tubes and other purposes, for its elaborate investigations of lubricating and fuel oils, and for its development of large amounts of electrical welding methods. The Navy's model bath at Wash.ington, moreover, is responsible for improved models, not only of merchant ships but many of the noblest steam and sailing yachts of the country. In this connection, it may be stated that the lines of not a few of the American cup defending yachts received their final determination as the result of trials in the Navy towing tank. When we come to aviation, we find that the Navy has rendered lavishly assistance. To its Hydrographic Bureau, we are indebted for extensive maritime surveys, and for the superb charts, issued regularly by the Hydrographic Bureau. The Navy has also rendered the passage of our great liners by locating and distributing by radio the position and course of those torpedos of the sea, the icebergs. Many a good ship has been saved from disaster by the Navy's wireless system, a Navy development by which ships as they approach the coast can obtain their exact locations, even when they are shut in by dense fogs and blinding snow storms. When a ship enters the harbor channel, she can maintain herself accurately within her narrow limit, keeping in electrical touch with a pilotable light on the bottom through the center of the channel. Only recently we illustrated in this Journal the new Navy system of sounding by sound, the practical operation of which was recently proved when a Navy ship charted the ocean floor from America to Europe in a fraction of the time which would be necessary by the old method.

Nor must we forget that the Navy gave to the steel industry in America the greatest single impetus which it has ever received. Thirty years ago, when we began to build our first steel ships, we possessed no steel that could fabricate the heavy forgings needed for armor plates and guns. Such things could be obtained only abroad, but the Navy arranged with American manufacturers to install the necessary plant for this heavy work, and it was this threefold policy which started our heavy steel trade on an upward course, which, within a few years, had made us the premier steel manufacturing country in the world. So far from its being an economic waste, the Navy is at once the police force of the nation, a training school for its youth, a great laboratory for the development of new industrial processes, and one of the greatest exponents of the true "live and let live" patriotism.

Adirondack Forest Preserve Threatened

THE ATTEMPTED raid by private interests on the Adirondack Forest Preserve by means of an amendment upon which the people of New York State will vote on November 6, is a matter which affects every State in the Union, for if the amendment should pass, it will suggest and encourage similar action by private interests against the forest reserves in other States of the Union.

The attack is being made under what is known as the Forster amendment to section 7 of article VII of the State Constitution, in relation to the Forest Preserve. Section 7 reads as follows: "The lands of the State . . . constituting the Forest Preserve . . . shall

for ever be kept as wild forest lands. They shall not be leased, sold or exchanged, or be taken by any corporation, private individual or partnership, nor shall the timber thereon be sold, removed or destroyed."

The Legislature may by general laws provide for the use of not exceeding three per centum of such lands for the construction and maintenance of power for municipal water supply, for the canals of the State, and to regulate the flow of streams. Such reservoirs shall be constructed, owned and controlled by the State."

Thus far the amendment follows the present constitution. It then proceeds to provide for private exploitation, by adding a clause which strikes at the fundamental principle of the present law. This reads as follows: "The Legislature may also provide by general laws for the use of such lands for the development of water power for the public use, and for the construction, maintenance and regulation thereof of ponds, structures, conduits and appliances necessary for that purpose—Such a development may be by the State, or by a lease of the State, (the latter are cured), under a lease for a term not exceeding fifty years, to be secured pursuant to law on such terms as will best protect the public interest and transmission lines may also be constructed, maintained and operated on such lands by the State or by a lease of the State, on like terms."

So there you have it, and for good effect, in its full bareness, attempt to take from the public that which the constitution has reserved for the use of the people. This proposed amendment is hardly to be surprised.

For look you, who read the present law expressly forbids the leasing of State-owned lands within the Forest Preserve to any individual or partnership for private exploitation, and yet the proposed amendment permits the leasing of such lands.

Whereas the present law limits any storage lands in the Forest Preserve to the use of water for municipal, public, canal and the regulation of streamflow, this amendment permits the building of conduits, power houses and electric transmission lines on these Forest Preserve lands.

Whereas the present law provides that any reservoir shall be operated by the State, the amendment provides that they may be operated by leases of the State, i. e., by private corporations.

Whereas the present law contemplates the use of large stretches of forest lands in the form of reserves for power houses and while and lengthy avenues closed of trees for transmission lines.

This latest raid upon the Forest Preserve is nothing new. More than thirty years ago, just prior to the SCIENTIFIC AMERICAN has raised its voice against the conspiracy, as we do today. Section 7 was adopted in 1884 expressly to save the forests on State land, and from that day to this the lumber and power interests have tried to break down that constitutional safeguard. In 1890 they attempted to pass an amendment which was defeated by a vote of two to one. In 1906 they tried again by last minute legislation which passed the Senate on May 1 and the Assembly on the last day of the session. It was denounced by the press and was killed in the next Legislature.

Only once since 1884 has this section been amended, and that was when the friends of the forests prepared an amendment, which was adopted and which permits, as stated above, only 3 per cent of the State-owned forest land to be used for storage for municipal water supply, for canals and to regulate the flow of streams, all of this for State purposes. The Forster amendment would invade the reserves with power-houses and cut wide swaths through the forests for the erection of unsightly lattice towers and the stringing of cables for the benefit of private interests. They would be protected by fifty year leases, under which they would be given for compensation to the State for the privilege and privileges granted.

Now more than ever, in the general election on November 6, the people of New York State will have an opportunity to register an emphatic "No" to the proposal to open our Adirondack forests for private exploitation.

The Father of Our Modern Navy

How Roosevelt Pulled the Navy Out of the Rut and Gave It a Fighting Edge

By Rear-Admiral Wm. S. Sims, U. S. Navy

HOW people realize the debt we owe Theodore Roosevelt for the development of our national defenses, especially our first line of defense, the Navy. Few realize the historical and technical knowledge he brought to bear upon this subject. The average man on the street does not know, or has forgotten, that during his young manhood, at the age of 24, he published one of the most remarkable historical narratives ever written by an American, *The Naval War of 1812*

It shows an understanding of the fundamental requirements of naval efficiency that few officers of his time had achieved.

The studies required to produce this book enabled him at once to understand the measures necessary to bring the Navy up to a state of efficiency from the deplorable condition into which it had fallen by the time he became Assistant Secretary of the Navy. He knew so well the qualities of material and training that make a ship a reliable battle unit that when our deficiencies in these respects were presented for his consideration he accepted the criticisms in the spirit in which progress demands that criticism should always be accepted, and in which they are so seldom accepted by the responsible authorities. He insisted upon a thorough investigation of the actual facts, the fixing of responsibility, and the immediate initiation of the necessary measures to correct our mistakes.

Before his efforts were interrupted by the Spanish War, he had appointed a board of officers to inquire into the causes of our inefficiency in marksmanship, and to recommend methods of training to remedy this. After the war he found himself opposed by officers who pointed to our successes at Manila and Santiago, and who strenuously objected to any public criticism of what they declared was a Navy that lost nothing to be desired in the way of efficiency of either material or personnel. He understood so well the conservative attitude of military men that he insisted upon an impartial presentation of the actual facts, and a comparison of those with the target practice records known to have been made in foreign navies. Needless to say, the record of about one hit in 50 at the battle of Manila, and of one in about 30 at the battle of Santiago, showed him the seriousness of the situation, and these records contrasted with the astonishing results of the marksmanship of training in the British Navy convinced him of the necessity of taking the matter in hand himself.

This he did by ordering the new British training methods put into operation, and ordering all our war and gun sights changed to make these methods possible with our guns. Within a short time the improvement was so astonishing as to be difficult of belief. The rapidity and accuracy of fire, the "hits per gun per minute," were increased to such an extent as to indicate that in battle we should be able in one minute to sink two or three of heavy projectiles against an enemy's hull at a distance of three miles, whereas, formerly, we would not have been able to hit an enemy more than twice in an hour.

It was an increase in efficiency of over 3,000 per cent. At the same time he gave his personal attention to the question of ship design, and to the significance of the new target practice records—the fundamental fact that the big turret guns could make a high per cent of hits at a distance of three miles, that small guns could make only a little damage. He at once advocated the All-British ship, the modern dreadnought, but he was told that the new type was opposed by the Navy Department. This opposition

he would speedily have overruled had it not been for a much more serious obstacle—the force of public opinion created by an article by Admiral Mahan boasting of the small gun as the principal battleship weapon. This made it impossible for the Congress to approve the dreadnought type. Nothing deterred him. He insisted upon an analysis of the subject for the purpose of showing that Mahan's arguments were based upon wholly mistaken information concerning the hitting power of a battleship's heavy gun at long ranges. These conclusions

IN ANSWER to my request for a Navy Day message, Admiral William S. Sims has written this fine tribute to the share of Theodore Roosevelt in the upbuilding of the United States Navy. On no side of his multitudinous activities did his penetrating mind and forceful personality work with quicker or more lasting effect. He was the danger of the reactionaries and the joy of the younger and forward-looking officers of the Navy. To his correction that nothing but the best is good enough for the Navy we owe, not only the rapid growth of the Navy in size, but, what is far more important, its advancement in efficiency. During the Roosevelt regime our gunnery became equal to the best in the world, our ships were rid of many serious defects; dangerous open turret mounts were abolished, and the whole personnel became thoroughly imbued with the Roosevelt enthusiasm.—THE EDITOR.

he gave to the press, thus bringing about the surrender of the Chairman of the Senate Naval Committee, who came out strongly for the new type, which was built with ordered design.

Unfortunately the first of these ships were badly designed, and at once criticized by Commander Key. These criticisms were opposed with all of the power of the principal dignitaries, but Roosevelt, as usual, insisted upon a showdown of all the facts. He caused the whole matter to be discussed by a body of about fifty officers in a conference which he opened in person at the Naval War College at Newport. The result was

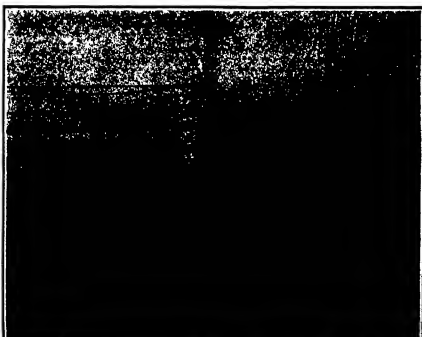
that a single example, he used his powerful influence to overcome the opposition to correcting the incomplete design of open turret mounts, and that the line of the gun platforms down to the magazines directly below. The danger of this design had been frequently pointed out, but it was not until it was demonstrated by the terrible turret accidents that resulted in the death of many of our officers and men.

The conservation caused by these accidents was such that the Department actually advocated the abandonment of all efforts to increase the rapidity of fire of our heavy guns, and advised that the records of our competitive target practices should be based upon the percentage of hits only. In this crisis Roosevelt showed comprehension of the wholly essential element of battle efficiency indicated by the phrase "hits per gun per minute," the standard of comparison then in use in our target practices. In a striking letter he gave orders that we should continue to make every effort to increase the rate of hitting—to put more hits into an enemy's hull than he could put into ours in a given interval of time, and he made it clear that it was up to the Navy to risk any dangers that such training might involve.

But more important still than the essential changes in design and methods indicated, was the change wrought by the great spirit behind it all. He saw the multitudinous activities did his penetrating mind and forceful personality work with quicker or more lasting effect. He was the danger of the reactionaries and the joy of the younger and forward-looking officers of the Navy. During the Roosevelt regime our gunnery became equal to the best in the world, our ships were rid of many serious defects; dangerous open turret mounts were abolished, and the whole personnel became thoroughly imbued with the Roosevelt enthusiasm.—THE EDITOR.

"Since then we have had a new Navy—Navy whose officers insisted upon efficiency, and therefore temperance, long before it was generally realized that the maximum mental alertness and manual dexterity necessary to efficiency in dangerous occupations cannot be achieved by men addicted to the cocktail habit. This great man jarred the old-time Navy out of its complacent conceit. He well understood, and he tried to make the Navy realize, that the greatest danger in a military organization is not, really, the lack of program, and the substitution of a comfortable idleness for the necessary preparation for war. He was never tired of quoting the remark of a disgraced bureau chief who complained that "my department was running smoothly and perfectly until this damned Spanish War came along and upset everything."

It is fitting that the birthday of this remarkable man should be selected as our National Navy Day. He was the father of our modern Navy. He instilled into it a spirit that brought into play the dormant, steel qualities of the personnel. He gave the word order the significance of a new meaning. He cared nothing for show, he gave no importance to appearance, and said the polished gun and gunnery that could not shoot fast and straight. He was impatient of ceremony. He related to his own, went into the fighting tops of battleships and had his hat blown off by the blast of heavy guns. He went down to the water level, and he was as real to the youngest gun as to the senior admiral. All understood that he valued the Navy only in proportion to its demonstrated ability to win the war in battle. He gave it the fighting edge. Though he is dead, this remains; for his spirit still lives and as a trained technician and an invaluable instructor in the art of battle.



President Roosevelt (seated at top of gangway) returning official call of Commander-in-Chief, United States Atlantic Fleet, on board flagship "Tennessee" at naval review off his home at Oyster Bay in 1904

that the defects criticized were corrected, as far as possible in ship type built. But, more important still, measures were ordered that would make sure the avoidance of such undesirable future designs; and since that time the design of our battleships has been second to none in the world.

In addition to correcting such vital importance defects as those above indicated, both in design and in methods of training, he gave his attention to many of the major details upon which efficiency depended. To



The "Virginia" as she rolled over to starboard before sinking in the September, 1922, tests. Bombs that dropped aboard threw down the two lattice masts and the three smoke stacks. It should be remembered that the ship was anchored; that she had no anti-aircraft guns; and that the bombs were dropped without interference, from the low elevation of 3000 feet

Has Sea Power Passed?

An Authoritative Exposé of the Extravagant Claims of the Air Enthusiasts

By Rear-Admiral Albert Gleaves, U. S. N.

SO MUCH publicity has been given to the alleged performance and capabilities of aircraft as an argument against the continued development of our Sea Power, that the Navy Department has uttered its official protest against the repeated attacks of the air enthusiasts who contend that Air Power is not only an extension of the Fleet, but that it has actually superseded it and rendered the battleship obsolete.

In the July number of the *Fortnightly Review*, Mr. Archibald Hurd says that the doctrine that Air Power has rendered Sea Power more or less obsolete involves not only the extinction of the Navy but the extinction also of the Mercantile Marine, "and we are offered nothing in place of the one or the other, which can be regarded as satisfactory, for the airplane has a very short radius and the ship is still a thing of the future, both are indeed, in the experimental stage." He points out that as airplanes have to maintain their own weight as well as the cargo, while the surface ship is borne by the water, that airplanes can never replace merchant ships, and the extinction of merchant ships would be the extinction of trade.

This is not written to discredit aircraft, but to warn against what President Roosevelt would call the "mischievous folly" of those who assert that our national defense and offense has passed from sea to sky. Every sea man believes heartily in the so-called "Three P's—Navy, aircraft, ships and submarines, and even naval storm repulse statements to the contrary.

The air enthusiasts base their arguments mainly on the bombing experiments against the Alabama and the German ships off the Virginia Coast, July, 1921, and reinforce their opinions with those of certain British Naval Officers. The controversy they have projected contains many factors, which if carefully examined, will expose the fallacy of their impetuous of battleships, guns and forts. Neglecting the immense importance of aircraft, our duty toward Air Power is plain. We

should, (1) Put aircraft of the right kinds and as many as possible on every surface ship belonging to the Navy (2) Build all the aircraft carriers we are allowed under the treaty and operate them with the fleet, (3) Armament the Navy with 10,000-ton destroyers and 10,000-ton small "cruisers" of such type (if there be one) as the limited displacement permits. Provide fixed air bomb defenses for the Canal, for our naval bases and for our great commercial ports, navy yards, and other vital positions. If we do these things we will have done everything the air development of the day warrants. More than this we cannot do under the Treaty.

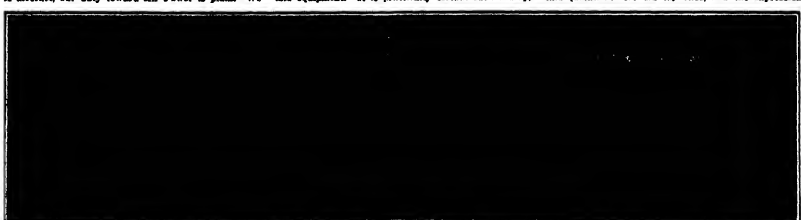
When the Conference for the Limitation of Armaments met at Washington, the United States was on the eve of becoming the greatest Sea Power in the world, a consummation naturally not pleasing to England which had held the trident of Neptune for 600 years, or to Japan which aspired to be in the Far East what England is in Europe. It will be recalled that the Conference agreed to restrict the number of battleships and airplane carriers, certain tonnages were also restricted as well as the class of guns. With few exceptions, American Naval Officers will remember the Conference with a pang of regret. To the air radicals, however, it was a boon. "We have enough battleships," they say, "forts are useless, and the only proper defense of our bases is by airplane, submarine and mine."

In every discussion of the question the air-enthusiast presents visionary, not to say fantastic, pictures to prove that Air Power has supplanted the sea and supplanted the battleship. A recent article describes the annihilation of the United States Fleet of 12 modern 30,000 to 40,000 ton battleships and the fortification of Honolulu, by a Japanese Fleet of 12 plane carriers of 10,000 tons, 25 more speed, each carrying 50 bombing planes. It is interesting reading and would make a good film story, but will unfortunately confuse and mislead the lay mind. This fact is a 10,000-ton carrier such as described could not possibly grow 50 huge planes with personnel and equipment. It is practically certain such a ship,

so far as may be even now, could carry only a few bombers and could not launch any. In the "battles" the plane defenses are allowed only a "few" planes and our fleet none at all except the light planes carried in the "Langley's."

The air enthusiasts when confronted with the poor record of aircraft in the North Sea, retort, "Air Power did not appear at Jutland. Today it dominates in warfare." Air Power did appear at Jutland and before, the Germans had highly developed airplanes at the beginning of the War and the English had airplanes. It was an airplane that discovered and reported the approach of Von Hipper's battle cruisers, and was driven off by gun fire when it attempted to bomb the German ship. As early as November, 1914, an attack by sea planes was planned upon the Zeppelin sheds at Cuxhaven, but in the pre-falling weather the planes could hardly get off the water. (World Crisis, p. 400) The failure of his aircraft to locate Zeppelin's Fleet delayed Von Scheer eight days and changed his whole plan of campaign. Air Power failed at Jutland and in Heligoland flight, because aircraft could not operate in a fog, nor can they now. They would have failed at Córnel for the same reason. The high speed of the battleships and cruisers in all the actions of the War—23½ to 28 knots—makes it doubtful if, with their present sighting appliances, airplanes could have succeeded either in the North Sea or in the southern seas. They were of some service at the Dardanelles when a balloon was used for spotting the shots of the Queen Elizabeth across the Gallipoli Peninsula and it was a success there only because it was used as an adjunct to Sea Power. Air Power and Sea Power are intertwined and interwoven as to be inseparable.

Opinions of distinguished British Naval Officers are quoted to impugn the battleships. Lord Fisher is the principal witness. He is quoted as saying, "Scrap the lot—referring to battleships." One wishes that, in the interests of truth, cheer and verity had been given for this quotation. He did say once, and the expression



Bombs across sea by the Army airplanes during the 1922 tests. The heavy falling gases formed a screen in front of the "Virginia" and "New Jersey," rendering the ships barely distinguishable in the distance

has been often repeated, "Back the lot, but I was referring to recapture of the Admiral, not to the battleship. On another occasion he wrote in 1915, "I am using sweeping parables." ("In the North Sea with Henty") again referring to the Admiral but to personnel. Lord Fisher was an ardent advocate of aircraft as auxiliary to the Fleet (Almirante) and he regarded "The Fleet needs air action," National Life Preserver" (Letters to Edward VII).

The enthusiasts of the Air School even invoke the spirit of Mahan in their arguments. It is impossible to conceive the great apostle of Sea Power as denying the doctrine he preached for 30 years, of looking upon surface vessels as "shadows of the past," as an air enthusiast puts it. Could he speak on the subject he would probably say, as he did when he approved the use of gas balloons during his words to suit the new invention. No airplane capable of carrying a launch of sufficient capacity, or of propelling it with such accuracy as to sink a battleship under war conditions is as yet in practical use, or has undergone adequate experiment; consequently we are ignorant of the facts as to whether the results would be of a decisive character or whether inferior in excess of that necessary to the end of warfare, the immediate disabling of the enemy, would be inflicted. Captain Mahan was a true prophet when he forecasted that the battleship would be found to be greatly overrated. (Life of Mahan "Tutor").

From one era of invention to another there must be a transition period of try-outs and experimentation. We do not shun the petty-arms and rifles, and the telephone, and the radio has not yet replaced the telegraph and the telephone, and fifty-odd years intervened between the first of wooden ships and the battleships of the super-dreadnaughts at Jutland. It may be we are at the threshold of a new era, and the airplane model of 1920 may be an intermediate step, between a 12,000 horsepower and 200 knots speed, carrying 50-ton bombs, as between Mr. Henty's, but in the meantime we must be prepared to meet a war with weapons in hand. The Navy, which is our first line of defense, must be kept up to the lightest efficiency, equal at all respects to that of Great Britain, and Germany and Japan's. It is unfortunate that the Limitations Treaty did not make this obligatory.

The Bombing Experiments of July, 1921—These tests, which have started so many controversies, in no respect simulated war conditions and these are largely the tests recently carried out against the "Virginia" and "New Jersey." The 1921 experiments were postponed from time to time until the weather was clear, the sea smooth, and the wind light. In all 75 Army and Navy planes were used. They flew in down over stationary, defenseless, unarmored ships, and undisturbed, dropped bombs of 150 pounds to 1000 pounds of high explosives. In 1922 the "New Jersey" was sunk at 9000 feet and the "Virginia" at 9000 feet. They have machine and light guns that can spray the air with allied projectiles at these elevations.

According to the report of the Joint Navy and Army Board on the 1921 experiments, the practice was not as good as was to be expected under the selected favorable conditions. It is a fact that it required 9 hours and 37 minutes to drop 75 bombs (25,000 pounds) on to a cruiser and destroy it, much more time than it took hitherto to sink by gunfire one battleship, one battle cruiser, and two cruisers and five destroyers and kill and wound 2800 men.

The "Ostrichland" was sunk by the minute effect of bombs which fell close alongside, this brought out nothing new because it is well known that mines can and have sunk ships, but it is not so generally known that unless the explosion is reasonably in contact with the side or within a few feet of it the effect is not serious. Even if a ton of T. N. T. was exploded 100 feet from the ship's side, the effect would be equivalent to the explosion of only 2 1/2 pounds alongside, not enough to injure a torpedo boat. To argue that the sinking of the "Ostrichland" was due to the fact that it was a small ship, is unavailing, practically at anchor, no one on board to pump out the water, and not protected by the latest underwater protection, "proves

that if our coast is protected by airplanes no ships can reach our shores or land from the air, or example, of special pleading which would not be admitted in a court of law.

In discussing this practice it should be remembered that the difficulty of getting hits with bombs or aerial torpedoes is vastly increased when the attackers stand off and the target is small. It is one thing for an airplane to stand toward a defenseless target dead, at its leisure, drop its bombs or torpedoes, but quite another to maneuver this way and that in the approach, fight off defending planes; and drop mines accurately. Right must be set for every change of course of the planes and to do this accurately requires some steering on the new course. Thus, when attacking a defended ship accuracy is enormously reduced and the per cent of effective hits becomes very small. Could airplanes get 100 per cent of hits (which is utterly impossible) in practice like that at the "Ostrichland," it would not prove easy

WE have long been of the opinion that there are few deficiencies in the makeup of the average man that are so destructive of clear thinking as the lack of a sense of proportion. The latest proof of this is to be found in the columns of ardent newsmen that are being printed these days, about the doom of the battleship and the dominance of the airplane. A few airplanes drop bombs on an anchored and defenseless old battleship and, presto! all battleships, even if they are moving swiftly and bridle with ensouled guns, are forced to believe. With indisputable facts and tremendous logic, Admiral Cleave in the article punches the airplane fallacy—THE EDITOR.

could get 100 per cent of hits when attacking against opposition.

One of the recent claims of air enthusiasts is that altitude does not play a great part in the accuracy of bombing. They claim that with improved ships bombing from altitudes of 5000 to 8000 feet can be quite accurate, in fact more accurate than from lower altitudes where the plane is under anti-aircraft gunfire. It is obvious that a bomb dropped from an airplane has an initial vertical velocity of zero, and being propelled downward only by gravity cannot have the accuracy of a shell fired with an initial velocity of 8000 feet per second. The low velocity, of course, greatly increases the error of the wind, speed of airplane, speed of the target, and earth drift. Nothing but a very high initial velocity of gun fire can minimize these factors; therefore air bombing affords no reasonable basis for the claim that the battleship is doomed. With the improved

guns. Also they assume that planes can go to and fro direct between the carrier and carrier, but cannot do so when, as a matter of fact, they have to search for their objective—and do not always find it. Leaving these considerations out of the account, it is very probable that Naval aviators and officers who practice with aircraft actually or on the maneuver board recognize these points; there are some others who do not.

Airplane Carriers. The big carriers will be equipped to carry 110 planes of various types; but the trouble with the carriers is not that they cannot carry so many heavy bombers, nor can the other type land or take off in rugged weather. To operate airplanes from a carrier the sea must be so smooth that the carrier can maneuver in launching or taking on planes, carriers must point nearly into the wind, and the waves must be so small that it is not so much to what extent that little fat interface with the airplane. It often makes carriers go where they don't want to go, and they don't want to go. Hence carriers cannot always launch and take on planes at the time they wish. If the wind is fresh or even moderate they must steam very slowly into it to get their planes off. If many surface ships are near, carriers have to run fast and frequently not to windward. At such times they cannot launch planes at all. It often takes the whole battle line to protect carriers while they are launching or taking on planes. Air enthusiasts don't seem to have ever heard of this fact.

Another point is that the air radicals never consider it the time it takes to launch planes from a carrier. Carriers can launch planes only one time in five, as very few carriers are able to take off, the rate of launching will probably not exceed one in four or five minutes.

For the purpose of making about one-half ton and therefore can, as yet, be launched only from planes sent up from shore. Although not fully developed the torpedoes are very capable. Already the air enthusiasts are making extravagant claims for it. They say that the carrier is the equivalent of a gun that can launch a 1000-ton projectile containing hundreds of pounds of explosives. They explain that the carrier having downed the target, 100 miles or so from shore, will send up its torpedo planes which will attack at dark or dawn, when within torpedo range (5000 yards) fire their shots unobserved by the enemy. They do not say how the carrier or planes are going to escape detection by a vigilant enemy who will be protected by a screen composed of submarines, destroyers and aircraft, arrows out of the distance of 50 miles from the battleships and the "train."

The last claim of the torpedo plane has only been partially tested in a war. In a recent target practice the torpedo plane was used to sink the "Arkansas" which was steaming in smooth water at a speed of 15 knots, and moving at 40 per cent of her normal speed. Of course conditions were totally dissimilar from war, and were all in favor of the plane. The "Arkansas" had to come down within 50 feet of the water to release the torpedo, and the maneuver was so complicated under war conditions they would easily have been destroyed by gunfire. The heat of the "Arkansas" was so encouraging, but an air enthusiast called it "an appalling example."

It is not true that the torpedo plane has only been partially tested in a war. In a recent target practice the torpedo plane was used to sink the "Arkansas" which was steaming in smooth water at a speed of 15 knots, and moving at 40 per cent of her normal speed. Of course conditions were totally dissimilar from war, and were all in favor of the plane. The "Arkansas" had to come down within 50 feet of the water to release the torpedo, and the maneuver was so complicated under war conditions they would easily have been destroyed by gunfire. The heat of the "Arkansas" was so encouraging, but an air enthusiast called it "an appalling example."

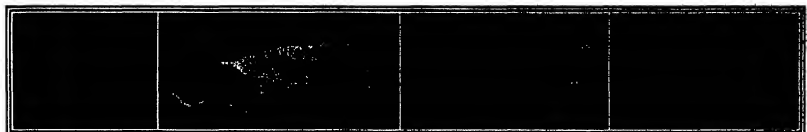
Bomb falling in the water near the "New Jersey." Such bombs, if they detonate sufficiently close to the ship, are more fatal than those which make a direct hit.

might the chance of hitting a vital spot, the coating tower, for instance, a ship from at low altitude, when exposed to anti-aircraft gun ranges. The probabilities by trial and error of hitting the deck of a large ship decrease from 50 per cent at 1000 feet altitude to 17 per cent at 8000 feet.

Airplanes carry from 500 to 1000 pounds of T. N. T. Planes carrying 4000 pounds are contemplated, but do not exist today. The heavyweight bombers cannot yet be launched from plane carriers and must be operated from shore. Heavyweight bombers by bombers have the radius of action, to 1000 miles at the comparatively low speed of 80 to 180 miles per hour. It is against such planes are greatly handicapped in attacking ships at sea. As one plane can carry but one large bomb, a torpedo, when that mine is launched the plane must return to the base or to the carrier for a reload. Air enthusiasts seldom admit this fact into their calculations.

Figure out, as a percentage of hits, how many

(Continued on page 372)



Dr. Olney emphasizes that the anatomical forms are usually perfect. Only three or four of the molds are defective, and even on them there are parts that show perfect anatomical form. The mold above every detail proper to human hands and feet. The general form, the bony prominences, the muscular outlines, the small bones, the lines, the fine marks of the skin. Nothing is missing.

Molds showing hands and feet of children. The two at the right are different views of the same mold, otherwise all four molds shown are distinct

Materialized Hands

The Franek Kluski Wax Molds, and the Conclusions that May be Drawn from Them

By Dr. Gustave Geley, Institut Metapsychique International

Translated for the SCIENTIFIC AMERICAN by Stanley de Bruih, M. I. C. E. (British)

THE STORY of materialized human members constitutes one of the most interesting episodes in the progress of metaphysical science. The sharp definition and precision of the results obtained, and the impossibility of attributing them to any kind of fraud, make them one of the most incontrovertible proofs of the reality of ectoplasmic manifestations. We may here remind readers in what these ectoplasmic manifestations consist. They are a kind of exteriorization of the physical personality of the medium. During trances a portion of his organism is externalized under the appearance of an amorphous substance which may be either solid or vaporous.

This amorphous substance then takes organic form, and from it it there appears new forms, which, when the phenomenon is complete, are capable of assuming all the anatomical and physiological characters of living organisms. The ectoplasm has then become a living being or a portion of such a living being, always, however, closely connected with the body of the medium, of which it is a kind of prolongation, being reabsorbed into his body at the close of the manifestation.

The phenomenon is sensually objective. It cannot possibly be explained by hallucination or illusion of the experimenters. This is proved by photographic examination. These wax molds are specially interesting. They reproduce the exact form of the materialized member and allow the thorough examination of every detail.

The materializations being very short-lived, only a very rapid process can be used for getting casts of them. The best, or rather the only, method fulfilling the necessary conditions, is by utilization of melted paraffin wax. This method was invented in 1905, in America by Mr. Denton, a professor of theology. It was also employed in London by Mrs. Beissner and Mr. Olney, who obtained excellent results. Since then, as far as I know, no medium has, till lately, been found capable of giving these molds, for the very good reason that none have produced complete materializations having three dimensions (length, breadth and thickness), a complete anatomical structure, and having impassably to allow of the operation of molding.

For this operation a tank is provided containing paraffin wax kept at melting-point by floating on warm water. It is placed near the medium during the seance. The materialized "entity" is requested to dip a hand or a foot, or even a part of the face, into the melted wax, repeating this two or three times. A coating of wax is thus formed, closely adherent to the part so dipped. This coating hardens very quickly in the air, or by being dipped into another tank provided in a neighboring tank; then

the hand or other organ is dematerialized and the "glow" remains behind. This "glow" is afterwards filled with plaster of Paris, and the cast is freed from paraffin by placing the whole in hot water. We then have a cast reproducing the materialized organ in every detail.

I shall here speak only of the experiments at the

laboratory of the Institut, and afterwards at Warsaw.

In Paris, the laboratory is a large bare room without windows. The doors were bolted from the inside. A dull red light enabled us to observe any movement of the medium. Mr. Kluski, before entering the laboratory, turned out his pockets, and I satisfied myself that he had no box or any other object in his possession. The experimenters, who were always five in number (Professor Richet, M. de Gramont, Count Potocki, and sometimes Colonel Okolowicz), sat around a table, on either side of the medium. Both his hands were held, by Professor Richet or M. de Gramont on one side, and by myself on the other. The medium soon fell into trance, his head resting on the shoulder of one or other of the persons next him, and made not the slightest movement. A luminous phosphorescent cloud proceeded from his body, especially from his head, organic forms appeared in condensed portions of this cloud of vaporous ectoplasm, and soon developed into hands and faces having all the appearance of life.

To obtain molds the tank containing the melted wax was placed on the table before the seance, two feet from the medium. The molds were formed on request. The operation usually began after a wait of some 20 minutes, and was accomplished very quickly—in one or two minutes. This was done at a temperature of the room does not solidify so quickly. According to Dr. Kluski, it would mean that the operating entities had altered the number of molecules in the air, and could so sufficiently to cause the mold to solidify) we give this explanation as given, to be only remarking that the hands of a medium in trance often become suddenly and considerably cold.

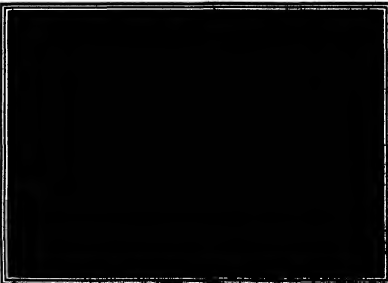
The operation took place in two or three stages, the acting hand plunged into the tank, came out covered with warm wax and touched the hands of the experimenters, then dipped again into the tank. After this the warm, still warm, was put down, usually against the hand of one of us. We obtained one or two molds at each seance. Later on at Warsaw we sometimes had three. In all, through the mediumship of Mr. Kluski we have had 25 molds, of which 17 are of a single hand, five of two hands joined, two of feet, and one of the lower part of a foot.

The size of the molds varies; some are full-sized male and female hands, some are those of children of 10 to 15, and some smaller, corresponding to hands of children from five to seven. In detail there are great heads of children of five to seven years old; one foot of a child of that age; and one connected to a child of 10 to 15 years old. All the other organs are those of adults.

The molds are very close to the real thing without the slightest joint, even when of

MUCH reference has been made, in psychic controversy of the past two years, to the paraffin casts of hands and feet obtained by Dr. Geley in the presence of the Polish medium Kluski. We think it probable that the bare existence of these molds has been known to most American readers interested in psychic matters. But when Mr. Brad was in Paris and saw the originals, he realized at once that no adequate account of them had appeared in America, if indeed at all in English. He accordingly arranged with Dr. Geley for a comprehensive article describing the molds, the mode of their production, and the procedure of the French investigators in reaching the conclusion that they were genuine. Dr. Geley has sent the manuscript, for translation, to Mr. de Bruih, who rendered into English Richet's monumental treatise "Thirty Years of Psychic Research," and who is himself one of the leading British spirits; and in this way our readers are assured of a translation that shall not suffer through any lack of special knowledge of the subject on the part of the translator. Whether or not our readers are prepared to follow the author in all his conclusions, they must realize that he presents a psychic document of the utmost importance.—THE EDITOR.

International Metapsychic Institute, referring the reader to the books by Professor Aleksoff (Axiomatic Spiritism) and by Delvaux (Les Apparitions Materialisées) for the story of the earlier experiments. Our molds of materialized human members were obtained through the mediumship of Mr. Franek Kluski during the course of the years 1920, 1921 and 1922, at first in



Two separate molds showing two hands joined

a hand up to the wrist. They are all extremely thin, the wax being only a millimeter thick and often much less. The walls of the molds were in places so thin that in *frying* they developed small cracks from which portions of plaster escaped during the subsequent casting. We call particular attention of readers to this tenacity of the skin of wax. We have shown these casts (to artists, painters, sculptors, molders and medical men. All have unanimously agreed that they are casts from human hands. One report from eminent artistic molders—Messrs. Gabrielli, Marchetti and Menzietti—says

"Our third remark is on the dexterity and truth of the anatomical detail. Life is to be felt under those strange and deceptive casts. It is obvious that these molds have been made from *living hands*. We find in them not only the anatomical details but traces of muscular contraction that can be explained only by movements directed by will. There are slight crumples of the skin which leave no doubt on the subject."

"From our long and minute examination we are compelled to conclude that molds so perfect, with such delicacy of detail, with indications of active muscular movement and folds of the skin, could only have been obtained on a living hand. They are molds taken at one operation, originals and not made from impressions."

Our certitude of the metastaphysic origin of our models rests on several proofs, some of which are absolutely irrefragable. First, the models are based on the control of the medium. I have stated above under the heading "The Medium" that the medium is the chief of these—the strict holding of both his hands should produce complete conviction. We can affirm that the medium is the chief of these at any time, should you wish to have for trickery. I always in my belief have been able to make the medium believe that I never released it. Still further, in the experiments at the Institute it was impossible to make the medium believe that I, controlling the medium, approached the table holding the medium in my hands, and I, controlling the medium, were in contact. Under these conditions, when we both should be quite sure that the medium was not in doubt, that Kinski's hands were completely immobilized, models were produced. I have, therefore, found that, several times observed the stigmata from the medium, and I have found them together. In such cases, it would have been necessary that the medium, to make models, should be able to move his hands both at the same time. This was absolutely impossible. The medium, however, that the medium could trick by making such perfect models by using the medium, and I have found it so, so absurd that it does not deserve discussion.

A second consideration is the proofs based on examination of the casts. We have already shown that our molds were indistinguishable from the known hands. This at once dispenses of the hypothesis of fraud by aid of an India-rubber glove. We have seen, however, that the prints produced by such a device are similar, though not identical, to those from an India-rubber glove. The prints from the boy's hands do not resemble those from a glove with water, dipped into paraffin, and emptied for withdrawal.

The cast can easily be done, although it is with care the experiment will fail as the thing floats on the top of the paraffin. The coating of paraffin must be thick enough to prevent fracture on pulling. Drawing the rubber glove over the paraffin is the last of the process. But the result obtained is characteristic of the paraffin used; there are some of the peculiar details of the human hand, even its general appearance is abundant.

An exceptionally fine adult female hand, on which the paraffin shell is no thicker than cigarette paper.

rubber or any supple object. Even supposing an artificial hand artistically prepared so as to reproduce the lines of the palm, the creases of the skin and the nails all complete, this simulacrum could not be distended with water without completely deforming it.

We think we have a right to assert that it is impossible to imitate our results with flexible India rubber. Could they be imitated by using a hard object instead of a soft one? We tried this, but found that the results were brittle. The object could not be reformed from the coating of paraffin, which always broke or was hopelessly deformed. In vuln did we give the waxen gloves considerable thickness to give it resulating power—no doubt, but the results were brittle. The gloves were too stiff. We ground the thing carefully and made a long slit in the narrower portion representing the wrist, so as to facilitate withdrawal, but in vuln All those who tried to use the gloves were disappointed. Some of the others might be more skilful or more lucky than we were, we should none the less be justified in asserting that it is not possible by using a hard object to produce a paraffin glove analogous to our own both in respect of

But another question immediately occurs. Can these super-normal molds be initiated by using a normal living hand? The answer is easy. It can be done, indeed there is no other fraudulent process possible, but this process is both imperfect and very difficult. We took every precaution against trickery of this kind. This, however, necessitates a long explanation.

The first point to be cleared up is—How can these super-normal molds be initiated, using a normal living hand? We know two methods that can be used. The first and simpler, consists in plunging the hand into



Child's hand, reduced about one-third from the original. Here perhaps more than in any other single cast the impossibility of normal removal of the original from the paraffin appears.

warm paraffin several times and awaiting the complete solidification of the glove (which takes 15 to 20 minutes in the air and from six to eight minutes in cold water). Then an incision is made with a razor or sharp knife along one of the edges, from the base of the fingers as far as the wrist. The hand can then be released by small lateral movements which detach it little by little from the waxen glove. The edges of the incision are then brought together and quickly re-dipped into the paraffin to conceal the joint and thus get a mold in one piece.

The joint does not show much if the operation is well done; but in order that it may be successful, one condition is indispensable—the glove must have 10 to 25 times the thickness of the super-normal molla. We have been unable by this process to obtain this glove, and therefore have been forced to operate with without the hand. Further, this process can only be applied to an extended hand. It would be quite impossible with one in the positions in the more surprising photographs shown. Also careful scrutiny always shows some trace of the joint. It can therefore be affirmed that this process cannot be used in the case of the joint, and that its control had not placed in an insuperable obstacle to its employment.

The second fraudulent process is more complex. It consists in using the hollow mold of a human hand and into this mold some substance such as melted sugar, which is both fusible and soluble, is poured. When solidified it is removed from the mold and dipped into the paraffin. If it is then placed in a tank of cold water and left till the cast dissolves and the glove remains. An improvement on this, we have been told of, but have not tried, consists in replacing the sugar by water frozen at 8 to 10 degrees (Centigrade) and then obtained. It can be quickly dissolved in melted paraffin and a very thin glove is thus formed, better than the cast begins to melt and efface.

the creases of the skin. The ice can then be left to melt and we can then get a glove as thin as desired.

I do not know any other fraudulent procedure. A Belgian engineer lately told me that he had invented a paraffin sufficiently elastic to allow of a living hand being released from it, but I have in vain invited him to give a demonstration of this. It is, however, of no importance for my case.

The ludicrous result that Dr. Geley gets when he makes every effort to duplicate the source results by use of a water-filled rubber glove

made them beforehand and had them surreptitiously. But so to certify that the molds were made at the scanner. We shall advance the proofs of both these

The proofs of this are numerous and conclusive. The control rendered a more delicate movements impossible. The digital imprints of the cast were found at the Prefecture of Police. Bayle, the highly distinguished, the Criminal Identification Service, not the finger prints of the man, but if it be objected that if not the medium it must be the hands of the experimenters, the answer is we have frequently had the hands of a medium, when there was no child and no child could have got into the room.

...not argument is decide. If then
...ulent molds must necessarily
...outside. But the molds were
...*then they were made during the*
...to have mathematical certainty
...and I decided on two means of
...in coloring our paraffin. Imme-
...periment. Our molds all had the
...the paraffin so prepared in the
...needed to mix with the paraffin
...in it and admitting of chemical
...notes of this crucial experiment

I chose cholesterol. I poured the warm paraffin. I tested the treated paraffin, for cholesterol the reaction was clear. This is well known it consists in dissolving paraffin in chloroform and adding gradually a red color, turning Ordinary paraffin without cholesterol when so treated. We had thus a way of knowing whether the molds were made with our own paraffin. This was confirmed with mathematical

had been made by myself alone in absolute secrecy. The tank on the rectangular table about two feet high was in the hands of the Control of the hands of the three men seated around the table. We heard the splashing in the tank and the successive phases of the operation. When this operation finished, the tank was empty, and we could see on the table the outlines, and extending to the right of the tank. One was the foot of a child, and the other was the foot of a child. (Continued on page 373)

(Continued on page 373)

The Animal Hospital

Surgical Treatment for Horses, Cows, Mules, Dogs, Cats, Goats, Canary Birds and So On

By William A. McGarry

HORSES, cows and mules can now be given surgical treatment for tumors, wounds, laryngitis, ruptures, broken bones, several tendons, distortions and many internal diseases that formerly made it necessary to shoot them. Such operations are being performed every week day in the year, not only for the purpose of getting information concerning rare diseases that may be of value later in treating human beings, but to save and prolong the lives of the animals and to increase their usefulness. And the same facts apply to dogs, cats and other pets, including rabbits, guinea, canary birds, parrots, monkeys and even the pampered skunk. They apply also to barnyard fowl—chickens, geese, ducks and turkeys.

What might be called the other side of the anti-vivisection story was brought to public attention quite recently in Philadelphia by the announcement that there had been set up in the University of Pennsylvania veterinary hospital the first operating table ever built for the accommodation of horses and other large animals. The machine was designed by Dr. John W. Adams, professor of veterinary surgery and obstetrics at the University and chief operating surgeon at the hospital, which is run in conjunction with the school. It was evolved after several years of experiment and after all existing apparatus had been found undesirable to the peculiar needs of the veterinary surgeon.

The table when put in use looks like a section of iron wall braced by leaning braces. It is oblong, and while standing on its side its width is a little more than the height of the tallest horse. At one end there is a projection to serve as a head rest, and the table is fitted with leather pads to prevent sliding, and with straps by which the animal to be operated on may be made fast to it. The procedure when an operation is to be performed is quite simple. The animal is walked to a position beside the table, which stands on its side. He is strapped securely to it and a liftboard is placed over his head. One of the surgical assistants turns a lever that sets in operation an hydraulic apparatus, and the table begins to tilt over, carrying the horse along in a few seconds the animal is on its side, restrained comfortably.

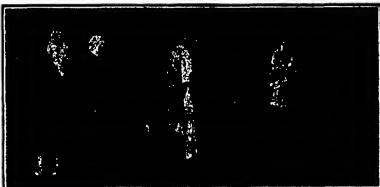
Another assistant then goes to work with the anæsthetic, using exactly the same methods as he would on a human being. The apparatus is larger and specially designed, and more anæsthetic must be used. In operation the human being it is customary to chloroform and then after the patient has begun to lose consciousness, to use ether. That is done because ether has a sickening effect, although it is not as hard on the heart and therefore not as dangerous. Horses, however, are almost immune to ether. It merely excites them. While it might be possible to render them unconscious by using enough of it, the surgeons prefer chloroform, and a quart of that potent stuff is required as a rule to get a horse ready for the knife.

Total anæsthesia, however, is resorted to only in case of a major operation. When the injury to be treated is local, as in the case of a surface tumor or abscess, incision, amputation or some other of the recently developed local anæsthetics are used, and Dolbin never knows that he has been all out up until long after he has reached his stall, when the effect of the drug is beginning to wear off. When the operation is completed the table is tilted again. In the case of a major operation and total anæsthesia, the apparatus is stopped at an angle of 45 degrees, and a heavy steel hand truck also designed by Dr. Adams, is run alongside. The straps are removed and it is then possible to slide the horse on the truck, which is wheeled to his stall. By a system of levers the truck is tilted and the animal slides easily



Testing a horse for tubercular germs through the snout

to the floor of his stall with minimum disturbance. Although this table has been in use only a few weeks, it has proved already to be one of the most



Students at the Veterinary School of the University of Pennsylvania inspecting cows for tubercular germs

valuable adjuncts to veterinary surgery. Heretofore all sorts of expedients were used in serious operations on large animals. Sometimes they were performed while the animal, unconscious, lay on the floor. That



Chloroforming a horse preparatory to an operation. It often requires a full quart to put a horse to sleep

made it necessary for the surgeon to kneel. At other times holding fast to one side of the horse to a table. The danger then lay in the injury that might be done to tissues already weakened by the operation, and various forms of hammocks had been devised. The lifting operating table makes all of these unnecessary.

Almost at the same time the table was set up for its first use an announcement was made in the newspapers of a marvelous operation by a Viennese surgeon, now on his way to Chicago to continue his experiments. He is said to have succeeded in grafting a complete eye from one animal to another in such a manner that it could see just as well as with its own eyes. As a rule, however, stories of experiments on living animals hold forth no such immediate and startling hopes as this. Many of the most important tasks of vivisection are for purposes that are never explained to the public, and hence when reference is made to operations on animals it stirs thoughts of supposed cruelty. That is why the University hospital story tells the other side of the anti-vivisection, for its primary purpose is the health and welfare of the animals it treats.

It was more than 100 years ago that the project of establishing a veterinary school and hospital was first broached at the University. In 1807 the noted Dr. Benjamin Rush made an address before the Philadelphia Society for Promoting Agriculture, urging that steps be taken in that direction, but nothing was done until 1868, when the school was started. For 40 years the school and hospital has been doing good to "human doctors" and saving the lives of burden and pet animals, but it is only in recent years that its surgeons have succeeded in developing a technique in many respects equal to that achieved by surgeons treating human beings. Twenty years ago the University, in cooperation with the State, erected a group of sanitary, fire-proof buildings specially equipped for the treatment and care of ailing animals, and these have been added to from time to time until the hospital is perhaps the finest of its kind in the world.

It is only a few years since it was the practice to shoot a horse or valuable cow or bull which had suffered a broken leg, and in many parts of the country that is still being done. The records of the hospital show 11 cases of fracture treated without amputation, and 10 cases of fracture treated in a year, etc. etc. The fact that a horse is more difficult than in repairing fractures of human bones, since in nearly every case considerable time elapses before the animal is able to stand, and the period he often suffers the broken ends of bones and irreparably damage the surrounding tissues. Therefore in five cases it was impossible to save the animal. The operative record for the last calendar year, however, is remarkable. In all there were 274 operations performed, for a myriad of reasons. Out of that number 146 were discharges, 126 were sent away as incurable, two died and 18 were destroyed. The list of large animals included 208 horses, eight mules and nine cows.

That, however, fails to estimate the extent of the service being given to mankind by the hospital. It is the record only of the surgical clinic. In addition there is a medical clinic for the treatment of human beings treated 131 cases, out of which 105 were cured and 126 were sent away. It is strange the result of finding a large animal which had been injured and it may be prevented with little delay. It is strange the result of finding a large animal which has been injured and it may be prevented with little delay. It is strange the result of finding a large animal which has been injured and it may be prevented with little delay. (Continued on page 321)

Engineering Softwood to Make It Hardwood

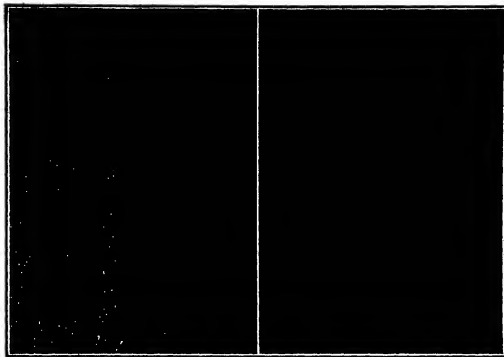
RESISTANCE there has been developed in Holland an industry which may bring about enormous alterations in the cultivation of hard woods. It has been possible to convert soft woods, by pressing, into hard woods, which present a very good appearance.

When one looks at a piece of wood in cross section, one finds all kinds of fibers and bundles of fibers closing cavities. These cavities are essential for the life of the plant, for they see to the transfer of water and food, as well as to the storage of reserve material. When the plant is dead, however, and the wood is going to be used, then these cavities are an unfavorable circumstance, because they lower the value of the wood. It is then just the quantity of fibers which governs the value. The more cavities there are, with regard to the number of fibers, the softer and more easily split is the wood. It is also a well-known fact that the natural hard woods are characterized by a very small quantity of cavities, compared with the number of fibers. From this it follows directly that as soon as one succeeds in diminishing the amount of cavities in a defined kind of wood, this wood must have better—or harder—properties. Although this idea is self-evident, it has only recently been realized in a technical way.

When a piece of wood is subjected to a uniform high pressure, along with a high temperature, the above-mentioned cavities are pressed in, and the piece decreases largely in volume. The necessary pressure of about 800 atmospheres must, of course, be applied equally on all sides, and this is best accomplished by using a liquid as the pressure medium. Water is unsuitable, however, for it penetrates into the wood and thereby the pressing effect is lost. A satisfactory medium has been found in asphalt, which only just penetrates into the wood, and then forms such a hard layer, that further penetration is impossible.

A whole tree trunk at one time is placed in an autoclave, dipped under the asphalt, and then subjected at a temperature of 100 deg. C. to a pressure of approximately 800 atmospheres for five hours. The trunk shrinks to about half its original size and greatly increases in hardness. One has to be very attentive and take care that the wood has a definite moisture content, because otherwise cracking takes place. If it is dried too much, the pressure medium begins to swell, as soon as it is brought in contact with moisture. Also, at the high pressures some chemical decomposition reaction takes place, which appears to be necessary for the success of the pressing. With insufficient care a formation of charcoal can occur, which causes a darkening in the color.

When the wood is pressed, the outer layer, into which the asphalt has penetrated can be sawed off, and from one can cut it up into whatever pieces of lumber are desired. These pieces possess a very beautiful marking, since the layers, already present in the wood, are now much



Cross sections of a piece of palm, showing (left) the wood in its natural state, with large cells, and (right) compressed to make it lignaceous, with hard wood characteristics

closer together. It makes a magnificent shining polish. Up to the present, lignaceous, as the product is called, has been chiefly fashioned into golf clubs, room bolsters, waiting tables, and luxury articles, but especially in the domain of inland work does it provide a good future. It is easy to understand that the natural hard woods in the future may experience a strong competition from lignaceous.

Angique—A Wood that Resists the Attack of the Teredo

TRUCK tests recently conducted in Dutch Guiana, it appears that a wood has at least been found which is immune to teredo attack. This wood is Angique (*Diospyros peruviana* Benth.), which is said to owe its teredo-resisting qualities to the presence of fine particles of silica in the fibers, which act as an abrasive on the boring apparatus of the mollusk. Physically, Angique is a dark brown, heavy wood with a specific

gravity of 0.851 when freshly cut and 0.746 when thoroughly dry.

Angique was subjected to teredo tests in the lock gates of the Surinam Canal, which lie just south of the city of Paramaribo, the capital of Dutch Guiana. This waterway connects the Surinam and Surinam Rivers. The water of the canal is brackish and the local government has experienced great difficulty in maintaining the gates and other timber structures because of the presence of the teredo. The gates were originally built of Demerara greenheart, a wood which gained much publicity during the building of the Panama Canal, as it was selected as the best wood known at that time for use in lock gate construction. In waters infested with teredos it was not long, however, before it became apparent that greenheart was being rapidly destroyed in the Surinam Canal, and the Dutch Guiana government undertook to find, if possible, a local timber having durable qualities that would build the locks.

Among the great number of woods experimented with was the native Angique which after five years' service in a particularly badly infested locality, was, for all practical purposes, found to be free from attack, while the greenheart placed under the same conditions was utterly destroyed within two years. Angique has been used since 1915 in Dutch Guiana by the local railway company to replace imported teak in the building and maintenance of railway cars. When properly dried it answers the purpose exceptionally well, although it has the disadvantage of being harder to work. In all places where toughness and resistance to abrasion are required, it can be safely recommended. Angique is found in three quantities in the eastern half of the province. Specimens six feet in circumference and 60 feet clear oak are common while trees as great as nine feet in circumference and having a full ninety feet of bole are not exceptional.

How to Make Lime Set Quickly

CONCRETE made by the Bureau of Standards developed a quick-setting lime composed of one volume of ground quicklime and two volumes of hyposulfite. The commercial success of this material depends upon finding some way to make it keep during shipment, or else to make it into finished form at the factory. Working on this latter phase of the subject the Bureau has been developing a cast lime partition. The experiments have shown the best composition to be one volume of wood fiber, five of quicklime and ten of hydrate, and that the best curing condition is outdoors exposed to the weather. Such a block sets so that it can be removed from the mold in ten minutes, can be handled in twenty minutes, can be sawed and nailed, and has a compressive strength of 100 pounds per square foot at seven days. It is about 20 per cent heavier than concrete of the same size, and experiments are now being conducted to see if the core volume can be increased without too great a sacrifice of strength.



Resistance of the teredo-resisting qualities of Angique (shown below) compared with greenheart (shown above). Both woods were subjected to five years' immersion in the same locality. The scale is about the size of an American quarter

Why Headlight Glare?

How Uncle Sam Tested the Headlights on 400 Ordinary Motor Cars and What He Found

By George H. Ducey



The car is placed 20 feet from the test screen that is used to diagnose the file and evils of headlamps which have gone wrong

ACCORDING to investigations made lately by national automotive engineers, the automobile headlights on 10 out of 20 motor cars are defective to the extent that they jeopardize the life and limb of other motorists who meet and pass them frequently. These Sam's official representatives tested out the headlights of 400 automobiles in the District of Columbia—these cars were very typical of the general run of homeless carriages used throughout the entire country—and found that 10 per cent of these were no longer fit in any way or manner as to endanger the safety of the operators and other motor car owners who chanced to meet them on the open highway.

In this day and age when most of the States—where automobile traffic is heavy—enforce stringent regulations about the design and adjustment of headlights, the fact that in the neighborhood of 10 out of every 20 sets of headlights violate State regulations through the carelessness of the car owners and drivers, is astounding. In the arts and industries, we are constantly reading about the formulation of new safety codes for this or that trade. The resources of science are yoked to the task of taking the doubt and danger out of hazy-about occupations. At the same time, we motorists, as a class, through sheer neglect are promoting a menace in highway travel by forgetting to maintain our automobile lamps in the most serviceable and efficient condition.

The results of the headlight search and research are startling to most of us when we understand that 73.2 per cent of the lamps tested were out of focus. You know how it feels to be driving along a slippery, slippy pavement, come a bright light and all of a sudden to have an approaching car almost blind you with its powerful lights whose beams have gone astray to the right or the left. If the figures are impartially representative—there is every reason to believe that they are—you may expect to be nearly blinded by the unsatisfactory lights of 73.2 out of every 100 motor vehicles that you meet. These facts and figures are astonishing enough in a very timid sort of way at home among nights, when the dangers from improperly adjusted headlights are maximum.

Not only is the headlight search with faulty lamps a menace to all those who meet or pass, but so also is a source of danger to himself and the occupants of his car. The lenses of his lamps may be so dirty that they only throw half enough illumination on the roadway—62.8 per cent of the headlights examined were suffering from dirty lenses. As a consequence, the driver may guide his car into the ditch or over a steep embankment just because his lights were so dim that he could not see where he was heading. Of all the cars inspected, 46.7 per cent had headlights that were not correctly tilted, 40 per cent had dirty, rusty or distorted reflectors, the lenses in 25.8 per cent of the cars were twisted in the headlamps, while in 23.6 per cent of the cases the headlamps were simply reduced to the average efficiency of the headlamps. However, they become dangerous when they do not transmit sufficient light to illuminate the surrounding scenery. Lack of focus, twisted lenses and lamps tilted upward result in a waste of light and throw a blinding glare in the eyes of the approaching driver. Headlamps that are tilted too far down light the highway for only a short distance in front

of the car. They produce a narrow cone of illumination about 20 feet deep extending from 20 to 100 feet ahead of the car, depending on the degree of tilt. When corrected, they should produce a broad cone of light extending from 40 feet in front of the car to 200 feet or more down the road.

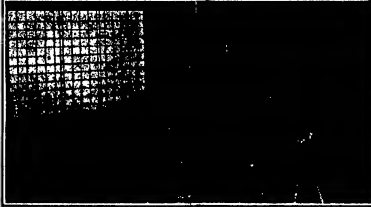
Study of the recent survey made of District of Columbia motor cars shows that over one-half of the cars violated the local traffic ordinances due to the fact that their headlights were glaring. In the main, this condition was due to improper adjustment of the lenses. There is absolutely no excuse for such errors of headlamps for it takes only a few minutes of well-directed work to correct them. Increased safety and greater road illumination are the worthwhile results of such activities. Time spent in checking and adjusting headlamps probably offers a better return than could be secured from a similar amount of work on any other part of the car, with the possible exception of the tires. In no one direction of automobile maintenance does the

obtain some light above the pavement as a protection against overhanging foliage and limbs, the pattern should be so adjusted as to appear slightly above the horizontal line in the center only. A space in the upper left hand corner about five inches above the horizontal and the same distance to the left of the vertical line intercepts the light which would probably reach the eyes of an approaching driver 100 feet away. This light, if sufficiently intense, is known technically as "glare." Special care must be exercised in adjusting lenses to see that none of the principal beams fall within this sector.

Fifty-seven different makes of headlights divided into three main classes were tested out in the recent Washington survey. The Bureau of Standards experts furnishing their services free of charge to all motorists who desired such assistance. Seventy-two per cent of the cars were equipped with devices approved by the last Motor Vehicle Administrators Conference; 23.8 were equipped with devices that were of some value but lay not on the latest approved lists, while 4.1 per cent of the cars carried devices that were practically worthless because they could not be adjusted to eliminate glare without decreasing road illumination below the limit for safe driving. Despite that good devices were installed on many of the cars, the headlighting was nevertheless defective because only 7 per cent of the best devices were in proper adjustment and over 82 per cent were dangerously glaring. In the second class of devices mentioned above, 53.4 per cent were glaring and only 1 per cent in good adjustment while all the lights in the third class were glaring. The installation of approved headlight devices on any automobile is merely the initial step in securing safe, clear and adequate road illumination. It is fundamentally important that these contrivances all be maintained in the same of adjustment if they are to function properly. Frequent and regular inspections are imperative. With the idea of educating the average motorist to the importance of keeping his headlights in proper tune, the Washington Safety Council plans on erecting a number of testing screens in different parts of the City of Chief Excellence that will be available to passengers.

It is essential that adequate headlight laws be enforced for the protection of the public. Attention is called to the proper adjustment of headlamps by the ten million or more motor car owners throughout the country that the Washington Safety Council would be glad with cases if all the offenders were to be found and fined.

Uncle Sam's representatives believe that future (Continued on page 874)



Laboratory test of automobile headlights for optical performance as well as for electrical dimming device

general direction public require direction and education more than in this simple little matter of lamp upsets.

The cars were tested for efficiency of illumination by driving them in turn into position about 20 feet from a special screen on which was drawn a horizontal line at the level of the lamp (about 56 inches) and two vertical lines spaced the same distance as the headlamps (about 28 inches). The inspections of these vertical lines with the horizontal lines represented the projection of the centers of the lamps to the screen along a

which the car stood. The lamps were focused and the lenses were polished so that defects in the position of the lamps could be noted and corrected. When corrected properly, the lamps would throw on the screen oval or elliptical patterns with the long axis horizontal. Spots which straddle the horizontal line would never reach a level road. Light falling 30 inches below this line hits the roadway about 250 feet ahead while rays striking 18 inches below the line illuminate the highway at a distance of 95 feet from the car.

Adequate glare illumination is secured by light that strikes the screen two feet to the side of the vertical line and nine inches below the horizontal line. In order to



Another view of the equipment used in testing automobile headlights. Note the swinging support and the change for holding different lenses



Components of the new recharger and its complete assembly. First, looking down into the recharger case, with chemical cell at right. Second, the electrode of bulkit metal. Third, the transformer and its connections. Fourth, the wooden case, with fins of chemical cell left partly exposed.

A Fool-Proof Recharger for Storage Batteries

THIS has lately appeared on the market a new type of storage battery recharger, which now takes its place alongside the vibrating type rectifier and the vacuum tube rectifier, for use in the home and private garage. The latest recharger is a chemical rectifier, complete with step-down transformer and leads, so that it may be readily connected with any 110-volt alternating-current supply.

The action of the latest recharger is dependent on an alloy called "bulkit," which is a form of the element tantalum. The material forms a one-way valve when introduced into certain acid or alkaline electrolytes, allowing one-half of the alternating current wave to pass through it, and completely checking the other half of the wave. In the commercial type the standard storage battery electrolyte is used in order to simplify care and maintenance. Furthermore, the recharger contains a two-winding transformer which allows the recharger to be used during the operation of a radio set, without any danger of blowing out vacuum tubes.

The new recharger is of compact dimensions and neat appearance. A sturdy wooden case contains the transformer and the chemical rectifying cell, and provides space for the battery leads and plug connecting cord. The recharger is virtually foolproof. It is entirely noiseless in operation, while a small red light, which may be viewed through a window in the transformer compartment, indicates when the recharger is working. There is nothing to adjust. It requires no attention except an occasional filling with distilled water. It cannot fail to charge the battery, and it cannot discharge the battery even when left connected. It cannot short circuit. It delivers a taper charge which decreases as the battery becomes charged, so that damage through overcharging is impossible.

The writer of these lines has found the recharger satisfactory in every way after prolonged tests with six-volt storage batteries used for radio work. The electrical efficiency of the recharger varies between 20 and 40 per cent, depending upon conditions. This efficiency, in view of the simplicity and thorough reliability of the recharger, is ample.

Tests on leakage indicate that the recharger may remain attached to the battery without danger of discharging it. The chemical valve will stand a back pressure of 300 volts before it allows current to flow through in the wrong direction.

A leading storage battery manufacturer has recently incorporated this recharger in a compact unit together with a storage battery. Thus, in a single wooden case, the rectifier element is secured a reliable source of filament current or plate current, or both, without the usual multiplicity of apparatus and the bother of connecting up.

Electric Heat for the Type-Metal Pot

It is well known that all isotopes, isotones and isomers and other forms of type-setting and type-casting

machines have melting pots in which the type metal is kept molten through the application and maintenance of sufficient heat. However, it is not generally known that the heat must be just so for satisfactory type casting, and that it must be maintained at such critical temperature within very narrow limits.

Gas is ordinarily used for the purpose. Electricity, which has been gaining more and more ground of late years, is considered a decided improvement on gas. On its face it would seem to be the real solution of an even surer of heat, but in actuality there are several troublesome factors that insist on popping up. One of these is line-voltage fluctuation, which causes a marked fluctuation in the type metal temperature and consistency, thus hampering the operation of the type-casting device. The average electrically heated metal pot requires anywhere from 2,000 to 2,800 watts of energy, which is a strain on the average electric light circuit.

The latest developments in this field take the form of the equipment shown in the accompanying views. A vibration thermometer is incorporated, in which the distance of travel of the pointer has been limited to one-eighth inch. The pointer is held constantly under spring tension against the positive contact. As the heat increases, the pressure against the pointer is built up until the spring tension is overcome and the needle snaps positively from one contact to the other. In cooling, the reverse operation takes place. This positive action insures perfect contact and the sensitivity of the needle is increased the more the machine vibrates. The actual contact end of the needle is a loose roller which must travel around a high point in moving from contact to contact. This automatically turns the roller on the spindle, and presents a cleanly scraped contact surface to each movement. This thermotatic control has a temperature variation of 25 degrees on the operating machine, and 30 degrees on the still machine.

A chemical investigation made at Columbia University proved that there is a critical temperature of

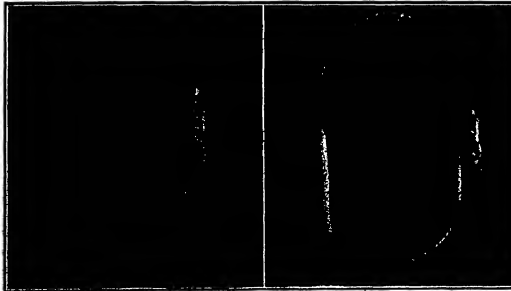
type metal. Between the limits of 730 degrees and 1000 degrees F., and in rising directly as the antimony content increases and also increasing directly as the temperature increases, there is a very decided action of the antimony on iron. The affinity of antimony for iron causes great activity of these two metals within those limits. The cleanly finished surface of iron or steel will be attacked at once, and in the case of thin sheeting the walls will be penetrated.

This was exactly the case of the immersed heating unit. The units were made of cleaned iron and presented an ideal surface for this action. The space between the heaters and the walls of the crucible would gradually become clogged with dross which acts as a heat insulator. The temperature of the metal in this space was naturally higher because the outside heater was also radiating heat in this direction. This natural, excessive temperature was very much increased by the above-mentioned accumulation of the dross insulator, which lessened the conductivity of heat from the unit itself.

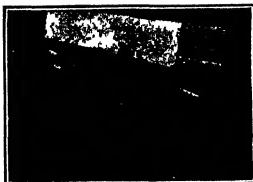
The melting point of tin is 449 degrees F., lead 600 degrees, and antimony 1150 degrees. When these metals are mixed, the melting point of antimony is lowered considerably. As the temperature of the metal increases to 800 degrees and above, the tin element as well as the lead element is gradually burned out to a certain extent. As the melting point of antimony is much higher, it is burned out more slowly. The result is that the disproportionate percentage of antimony is increased as the percentage of the other elements is decreased. The very high temperature in the space between immersed heaters and crucible walls foster this condition. The increased percentage of antimony and the excessive local temperature of the mixture set up the most satisfactory conditions for the chemical action of the antimony on the channel above. This still, therefore, has often been attacked, penetrated, the metal seeped in and the unit was short-circuited.

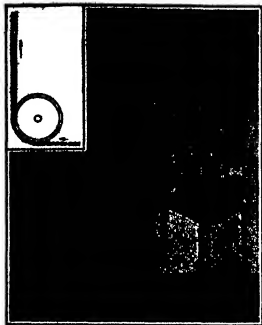
In the course of scientific research to establish the action of antimony on iron, it was also necessary to find an element which hindered this action. Of all those tried, the most effective and most economical was found to be the scale surface on iron castings. If this surface was penetrated by filing or machining, the action was the same.

The nichrome wire heaters were inclosed in drawn steel tubes. It was necessary to manufacture these tubular units so that they could be immersed in molten iron at 2800 degrees F., and allowed to remain there until solidification without fear of melting. The danger of explosion, due to moisture within the tube, was also acute. The manufacture of suitable units has now been successfully accomplished and the tubular heaters are covered by not less than one-eighth inch of cast iron. It is impossible for the antimony to penetrate this construction and the bottling of the type metal is at its least.



Left: Improved type of electric type metal heater, with vibrating type of thermometer control. Right: Internal details of the vibrating thermometer.





A belt-conveyer for messages which works on a novel principle

Something Different in Belt Conveyors

It is decidedly unusual design in the belt conveyor recently installed in the Berlin trunk line telephone exchange. It takes the place of the flat-tube pneumatic mail installations formerly in use for the transmission of order slips. The new belt conveyor comprises a belt passing along the trunk line record tables and is based on the fact that the friction coefficient of paper on metal is only half as much as that of paper on textile fabric. The order bulletin is slipped between the traveling belt and a plate of sheet metal guided to guide it and, on account of the greater friction, adheres to and moves along with the belt. Inasmuch as the same scheme would seem to lend itself to many other applications in connection with the conveyance of large quantities of letters, slips and other light objects, it is of more than passing interest.

The essential idea of the new belt conveyor is made clear by the drawing which shows the whole belt, the sheet metal guide, the letters or slips of paper, and a pulley part of a typical installation is shown, with ups and downs and sharp curves to demonstrate the flexibility of the system, as well as the electric motor drive. It will be understood that the belt does not have to be continuous. An ingenious mechanical arrangement permits of transferring messages or letters from one belt to another, and there is even a possibility of guiding the traffic through angles of less or more than 90 degrees by providing an auxiliary pulley which, by means of sheet metal plates, connects the two belt sections. In the case of paper slips of constant size the belt should preferably be adapted to the width of the paper. The paper slips or other light objects conveyed by the belt are, at the opposite end, discharged over a pulley into a hopper.

This ingenious German system has some advantages over the usual message-conveying systems now in use. Its simplicity and low cost are, of course, the main advantages, while the ease with which it turns corners and climbs up or goes down makes it more flexible than a plain belt conveyor found in some telephone offices.



A new machine which may revolutionize the working industry

The World's Largest Gasket

A CHICAGO manufacturer of gaskets has, it is claimed, made a larger gasket than any in the world, and as this concern is the largest gasket manufacturer in the world with a consumption of gasket fitting. Measuring 10 feet 9 1/2 inches in diameter on the inside and a full 11 feet in its greatest diameter this mammoth gasket required, in order that it might be kept advantage by a photograph, the support of three men, one standing well up on a lofty step ladder two mounted on high ladders above. But the gasket may be handled with ease and if shipped without dissection or bending would require a good bit of a freight car.

Directive Radio Transmission on a Wave-Length of 10 Meters

UNTIL recently radio communication was for the most part carried on from a transmitting station to one receiving station—that is, it was point-to-point communication. There were only a few special kinds of service, such as time and weather signals, which were transmitted from a sending station to any considerable number of receiving stations. However, even in the case of 'point-to-point' communication, radio signals were sent out in every direction and could, if desired, be received by any station within a certain distance regardless of its position with respect to the transmitting station. Since the total number of messages sent was small, a comparatively small number of wave lengths was sufficient to take care of traffic requirements. With the development of radiotelephone transmitting apparatus, the broadcast nature of voice or music by radio has assumed an important position and the waves used in this work occupy a wide band of the much made use of the short wave length which it occupies, considerable interference has developed among broadcasting stations and between broadcasting stations and other stations.

There are two ways of reducing such interference. To direct the waves from the transmitting station in the direction of the receiving station is one way to employ in much transmission shorter wave lengths than have heretofore been used. In England investigations have been made of the short wave transmission and at the Bureau of Standards experiments have been conducted on transmitting apparatus employing iron tubes which transmit a directed beam of radio waves and employ waves as short as 10 meters. In these experiments a reflector has been used consisting of short, parallel, vertical wires arranged in a frame shaped like a parabola or reflector functioning in much the same way as the mirror for light waves. Forty vertical wires were used and the generating net with its small antenna was placed in the focus of the parabola, each wire was tuned separately to 10 meters by adjusting its length, and it was found that about 75 per cent of the radiated energy could be confined within an angle of approximately 75 degrees.

This apparatus is described in 'Scientific Paper of the Bureau of Standards No. 467 and can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 10 cents a copy.

Fatigue Tests of Limestone

AS noted last month the Bureau of Standards is carrying out a series of tests to determine to what extent stone will fatigue under a continuous load. The specimens are prepared in the form of beams which are supported at the ends and have a load suspended from the center which is calculated to give a stress in the stone equivalent to two-thirds of the ultimate strength. Deflection measurements are being made at intervals to determine if there is a continuous sagging which, apparently, is the case according to measurements which have been made to date.

Dressing a Codfish Every Second

ON the foggy Grand Banks the most arduous task of the cod fishermen is 'dressing down.' Everyone dreads it, for it means working regardless of hours until the job is done. If the catch has been heavy, midnight, or even the dawn following, men often crawl head up at it by the light of flares. No one, not even the cook, commonly known while about as 'the butcher,' may have any respite. The deck is slippery with parts of the thousands of cod that have been laid out from the knifes of the slitters into the hold. Out fingers are of no avail as the crew goes for laying off.

Power has taken a lot of the meanness out of life at sea and the same little gasoline engine that boats the fisherman has taken the labor will now have men to do and the crew, less 'the Iron Splitter' does the work.



An eleven-foot metallic gasket

of 60 to 75 men who now wield sharp knives on the Grand Banks off Newfoundland up along the Labrador as well as in the localities frequented by fishermen from France, England and Scandinavia. Every second the new machine takes a fresh codfish and as often it turns out a dressed fish. It performs all the usual operations of splitting, removing the backbone, cleaning and washing. The impulse machine was patented in Seattle, Washington by the company which perfected in 1909, a somewhat similar machine called by fishermen 'The Iron Splitter.' To use it took the place of thousands of Chinese who were formerly employed to clean fish in the salmon canneries of the North Pacific.

More 'Talking Lamps'

MOTORISTS who pass through New York at night will find a device installed at the intersection of five principal streets which not only enables one policeman to control the heavy motor and street car traffic at a congested point but controls it better than any other officers who were formerly stationed at this intersection were able to do. In the photograph, the three policemen at the corners revolve with the one forward and one stationary. Beside the latter stands the single traffic officer whose duty it is to control the entire group of beams. By pushing a button on the side of the distant beam he simultaneously revolves the other three beams each of which bears the usual 'Go' and 'Stop,' as well as the cars spending green and red lights for night signaling. In addition to these signals there is a green in which because this automatic strip lights, the turn turns time giving, an audible as well as a visible signal.



A remarkable group of four traffic beams which is controlled by a single officer



QUEER STREAM-LINED CRAFT THAT MAY BE USED AS A HYDRO-PLANE, RACING AUTOMOBILE, AMPHIBIOUS BOAT, OR NON-SINKABLE LIFEBOAT.—(See facing page for description)

With the Men Who Fly—II

How the Glider Flights of German Students Have Brought About a New Era in Aeronautics

By Alexander Klemin

Lecture on Aeronautics, New York University

DURING the war, in the desperate struggle for air supremacy, the most direct method of attacking the enemy was to have more speed and climb secured by the use of greater and greater engine power. In other words, by brute force. This tendency persisted for several years after the end of the war. It is true that there has been improvement in wing sections, in the aerodynamic cleaning-up of wing trusses, in the careful fitting of bodies and projecting parts, in the introduction of wing radiators which do away with the resistance of the ordinary automobile-type radiator. But even more high powered machines are still used, a single-engine fighter being commonly equipped with 300 to 400 horsepower. This tendency unavoidably results in the design of commercial planes, with high power and large gasoline consumption, retarding commercially the profitable application of aircraft.

Aviation History Repays Itself—Glider Flights

But while the United States, Britain and France continued to pace themselves to develop their airplanes in the same direction, the Germans, forbidden by the International Allied Commission of Control to build high-powered planes, made an extensive study of the more subtle art of gliding. This enforced speculation may be a tremendous boon for aviation, as it may pave the way for low-powered planes and mark a new era in airplane construction.

Often hampered by lack of funds, working under extreme difficulties, German builders had the advantage of cooperation by their universities, and rapidly developed both wonderful machines and skilled glider pilots. German pilots achieved a truly remarkable control over their machines, actually describing figure "8" flights and other evolutions in motorless flight, and for a long time the German pilot Heintzen held the world's duration record for gliding of 5 hours 0 minutes, until this was beaten by the Frenchman Minervet at the Lewes meet in England, October 21, 1922, when he remained aloft for 5 hours 17 minutes. Since then the German pilots have kept the lead and the world's duration record is at present held by the famous French pilot, Georges Barbot, who, at a meet at Biarritz, Algeria, stayed aloft for 8 hours 8 minutes. Among other interesting achievements Fokker, the famous Dutch designer, has kept aloft for 13 minutes, carrying a passenger, and an English pilot, G. R. Olley, soared with a passenger for 40 minutes at the same Lewes meet. In the United States, Glenn H. Curtiss, one of the early pioneers of the airplane, built a miniature flying boat with which he has achieved a number of short glides, when released from the towing rope of a flat motor boat. It is ultimately hoped to develop this form of gliding to the point where the coast is now may be a sufficient impetus for the start of a glide. At present, being towed behind a motor boat and cutting loose provides a thrilling sport with very little danger.

The question naturally arises whether these remarkable duration flights are a mystery; whether we are approaching the soaring power of birds and shall ultimately be able to fly from point to point at will without the use of power. The answer is that there is no particular mystery about gliding, that it follows the ordinary laws of aerodynamics, that duration gliding is a question of good control, suitable conditions and a good machine suitably controlled. When under perfect conditions duration gliding is limited only by the physical endurance of the pilot, and the pilot, in a point at will to not get in sight, although it is theoretically possible by utilizing the internal energy of the bird.

The principles of gliding are simple enough. To still air, the glider must have a certain forward velocity so

that the wings give the necessary sustentation or lift, achieving this forward velocity the resistance of the air acts on the wings and the rest of the glider and absorbs energy. This energy is supplied by gravity. In other words, the glider must move altitude to sustain its gliding flight, and flight is not horizontal as in the case of machines where sustentation is overcome by the power of the motor acting through the propeller, but on a downwardly inclined plane. In a good glider the resistance of the wings and of the rest of the machine is reduced to the minimum, the least possible energy is lost and the glide is a gentle one. In the first gliders such as those used by the Wrights the glide path was one in five or six. In the best German gliders the glide path one in sixteen, or, in other words, in a glide of 16 feet only one foot

selves indefinitely in this manner. Gliding is a matter of sailing, where great skill must be used to utilize favorable winds.

But if the glider is no mystery, if duration flight only is not slight from both the pilot and the machine achieved—if at present it is but a fascinating sport, gliding flight has great usefulness in both scientific and practical aviation.

In the construction and design of experimental airplanes, the glider may serve as a most useful adjunct. It is extremely expensive and disappointing to build a large airplane and find its aerodynamic efficiency or control to be poor. The glider may furnish a ready and cheap method of experimentation with lessons directly applicable to the powered machine. Efficiency, stability and control may all be studied out cheaply and easily in this manner.

What Aviators Learn Through Gliding Flights

But besides being a possible adjunct to the testing of experimental airplanes, the glider *per se* will forward the aerodynamic efficiency of airplanes in general. The efficiency of an airplane is inversely proportional to the gliding angle or inclination of the glide path. In other words, the more gentle the glide path of an airplane, the less the power required to pull it through the air. Gliding paths of commercial airplanes as at present designed are seldom better than one in eight. And the result is that about 60 horsepower is required to carry an airplane passenger on a three-hour journey at a speed of 200 miles per hour. Under any circumstances, builders of gliders have improved the glide path up to a value of one in sixteen, as in the German "Hanover" glider. There is no reason why the same increase in efficiency should not be attained in the construction of full-scale airplanes, with the corresponding improvement in the economy of airplane transportation. Gliders must also be light, as otherwise they might have good glide paths and yet have a high rate of downward velocity in still air; and also because a heavy glider is more difficult to launch. Builders of gliders have accordingly learned to build light, while maintaining a reasonable factor of safety, and the structural lessons learned thereby may also be translated into airplane practice. The glider, moreover, is a splendid and inexpensive school for pilots, and a safe method of weeding out men who should never be pilots.

But the greatest immediate value of the glider may be in the fact that it has given to the construction of low-powered aircraft a new impetus. The three small air-crafts of the low-horsepower glider of a few horsepower that you see with them, such as the German "Kitt" three-cylinder motor machine which weighs only 11.5 pounds complete and develops 1.5 horsepower.

The Advent of the Low-Power Plane

It is really remarkable what can be achieved with the use of small power. The German "Bulg" motorless glider, described with a tiny low-horsepower motor, can rise from any ground, glide in any direction of the wind, and maintain slight, indefinitely.

Georges Barbot, holder of the gliding duration record, flying in a Devoine motorless glider, described with a tiny low-horsepower motor installed in the same Devoine machine,

IN the October issue Mr. Alexander Klemin gave us a broad survey of the conditions of gliding. In the extraordinary advances in engine design, and the steady progress toward night flying, all of which comprised the broad range of gliding. In the present article Mr. Klemin, who is a recognized authority in the broad field of aeronautics, reviews the progress in gliding flight and speculates on its importance in airplane design. This article was to conclude the series, but so great has been the activity in aeronautics during the past month or two, that we have asked Mr. Klemin to write a third article which, unless aeronautical progress keeps up at its present brisk

review of recent events and their significance.—THE EDITOR.

altitude is lost. This shows what tremendous progress has been achieved in gliding, in minimizing the resistance of gliders, and also of airplanes, which are naturally built powered gliders from one point of view.

But this is speaking of gliding downwards and does not explain how light is maintained indefinitely. However good the glide path, the machine will ultimately reach the ground unless there is a rising current of air. The rising current of air supplies the energy which must otherwise be obtained from the action of gravity by balloons.

The skill of the glider pilot is in finding a terrain where there is an upward current of air to supply this energy. When the tide current falls, the aerodynamically efficient machine loses little altitude, and the pilot, by a series of maneuvers his machine that he promptly finds the rising current which may sustain him or even give him a slight altitude. And we see that gliding, as well as modern gliders seem to be able to maintain

Cryolone successfully flown at MacBeth, July 16 last. Power. About one of the prizes, routing gliders for night flying.

made an official maximum speed of 30 miles per hour; nevertheless, the plane, which was built of seven balsa wood and trevel 80 miles on a mile of gas. The most striking achievement of the motorless glider is the record of the English glider, which was built of seven balsa wood and trevel 80 miles on a mile of gas. The most striking achievement of the motorless glider is the record of the English glider, which was built of seven balsa wood and trevel 80 miles on a mile of gas.

Saving a Cathedral

Restoring Lincoln Cathedral by the

by Compressed Air

Compressed Air Drill and Grouting

THIS is the story of the rescue from collapse of one of the greatest cathedrals of Great Britain, by means of the compressed-air drill and cement grout forced into its fissured walls under air pressure. Much as we may admire the architectural beauty and wonder at the size and majestic dignity of the medieval cathedral, it has to be admitted that in many of them the work of these early masons was of very rough and inferior character. This is particularly true of the early Norman work of the twelfth and thirteenth centuries. The construction during the fourteenth, fifteenth and sixteenth centuries was generally of a better quality.

The trouble with the Norman work was that the massive piers, ten feet to twelve feet in diameter, and the walls from six to eight feet in thickness, consisted of an inferior of rough rubble work set in mortar, with an outer casing of dressed stone with squared and fairly well-fitted joints. In the course of the centuries the mortar, which was often of an inferior quality, deteriorated and lost its binding and holding quality, and from the thirteenth century down to the present time much of the early work has given unending trouble. Naturally, the principal difficulty has been experienced with the towers, and particularly those at the crossing of the nave and transept. Here the superincumbent tower load, of from 3000 to 5000 tons weight, proved too much for the four piers upon which it rested, with the result that in many of the cathedrals, both in England and France, the piers have crumbled or buckled, and the whole tower has come crashing down upon the church below. This happened at Winchester, Chichester, and to the first central tower at Lincoln, not to mention several others which suffered the same fate.

Several massive towers have been saved from collapse, during the reconstruction work of the last one hundred years, only by emergency repairs in which the tower above was held up by a perfect forest of massive timber shoring, while liquid cement grout was poured into the interior rubble work to bind the mass once more, as far as possible, into a solid and unyielding support.

The present article deals with the northwest tower of Lincoln Cathedral which, in our illustration, is the one to the right showing above the main roof. The lower part of the two western towers, to about the level of the ridge of the roof, is of Norman construction as will be evident from a study of the round arched windows and the plain square buttressing at the corners. The upper part of the towers was added in the later reconstruction and enlargement of the cathedral. This Norman work is characterized by the rudeness of construction referred to above. The present dangerous condition of the northwest tower, as shown in our photograph, is due partly to the nature of the construction, and also to the fact that the cathedral was badly wrecked by a violent earthquake, which took place in the year 1185, and necessitated the rebuilding of the Norman Cathedral.



Western towers of Lincoln Cathedral. The right-hand tower, it will be seen, leans to the right.

The cracks which were opened by the earthquake in the northwest tower, in spite of the continual repair work done at various times during the past seven centuries, have steadily widened, and the tower has settled in a northerly direction until the deviation is visible to the eye, as will be noticed from our photograph showing the western towers. The condition of the towers, and indeed of many other parts of the cathedral, was so serious that a vigorous campaign to secure the \$200,000 needed to save the cathedral was started a few years ago and the present work of thoroughgoing repair was undertaken in 1922.

The walls of the tower are enormously massive, reaching in one place a thickness of twenty feet, nevertheless, in one wall the crack had opened to the extent of twelve inches. It would be impossible to pull the wall back into its original position, and what is now being attempted, and very successfully accomplished, is to fill up the cracks with grout and thus hold the structure from any further distortion or settlement. This has been rendered possible by the use of a very efficient American tool, the compressed-air drill. With this most useful tool holes are drilled many feet into the heart of this wall, and liquid grout is forced into the mass of masonry, where it follows along every crevice to the

utmost extent of the fracture, filling all the voids and binding the rubble work into one solid and impenetrable mass. As compared with the old method of drilling by hand, the use of compressed-air drills and of pneumatic pressure for forcing the grout has cut down the cost of these repairs enormously. Indeed, it may be said without exaggeration that the compressed-air drill has saved this magnificent cathedral, which has been visited by thousands of Americans, from destruction. A considerable part of the funds for the work has been contributed in America; and the Dean and Chapter have decided to make the repairs to the lesser central tower at the crossing, which is not visible in our photograph, entirely with such funds as are subscribed in the United States, and to constitute this work a memorial to American cooperation. Of the total sum of \$500,000 required for this tower about one-half has been subscribed.

A Photographic Museum

IN Prague there is a wonderful museum devoted to buttons and other fastenings for clothing. It was founded by a button manufacturer who thought that, as his fortune had been derived from these humble objects, it would be a graceful thing to found and endow a special museum of this nature. The other day we were reading a letter in a daily paper which gave an excellent idea for a museum, and we think it is worth while to pass it on to our readers. The letter suggested that Mr. George Eastman found a museum of photography. The idea is fundamentally sound, as it would be most appropriate for one who has done so much for photography to go a step further and collect all the historical memorabilia while they can be collected. Of course, Mr. Eastman's profits are legitimate and are his own, but he has shown such great generosity in founding cultural schools of music and the silent drama, that it would not be impertinent, we think, to suggest to him that he is the logical person to start such an institution, the museum to pair with his great laboratory where so much work in pure science is carried on. Of course we have a few exhibits in the National Museum of Washington and the Science Museum in London, which are useful as far as they go, but what is needed is a real museum containing all possible exhibits which will elucidate this beautiful art.

Tests of New Design of Large Hawners

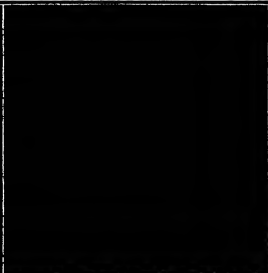
TWENTY tests have recently been made at the Bureau of Standards on 21 samples of very large hawners. The purpose of these tests was to determine the comparative strength of a new type of construction for manila rope as compared with the standard method of construction. In the new type the inner yarns of the strands are untwisted. The strands are made up of several outer layers of twisted yarns binding this inner untwisted mass of fibers, three strands being twisted in the center of the rope. The tests showed that in all cases the new type of construction increases the strength of the rope.



This wide crack is typical of the disruption that was taking place in the old Norman Tower.



Even this lower window, 120 feet above ground, was falling apart. Note the temporary props.



Cement grout forced at high pressure into holes drilled in the masonry between the walls mass.



Left: Dropped through a glass tube upon a hardened steel plate the ball's rebound is a measure of its hardness and resiliency. Center: Tap-grinding the steel sphere to determine its exact diameter. Right: Examining the balls with a 30-power microscope, in the search for surface imperfections. Tests and checks to which high-grade ball bearings are subjected before they leave the factory.

Ball Bearings and How They Are Made

The Tiny but Perfect Spheres that Keep Down the Friction Toll in Modern Machinery

By Robert G. Sherratt

THERE was a time, and that not long ago, when a lubricating film of some sort was the only means of effecting the slippage or lumping contact between antagonistic sliding or revolving surfaces, and, even so, there still remained the demand for more or less unproductive power to overcome the inertia of the "dead load" and to keep the mass in motion. Thanks to the development of ball and roller bearings the effect of these physical conditions has been very greatly altered for the better, a lesser effort can achieve more than was feasible before the adoption of these beautifully and accurately fashioned bodies of steel.

There are no statistics available to tell the whole story of America's annual production and use of these small frictional parts, but the output is numerically immense, and the fields of application both wide and manifold. They have a place in the get-up of every automobile, motor truck and tractor; they are employed by the millions in electric motors, sewing machines, talking machines, typewriters, geoscope compasses, and an endless variety of other mechanisms, and thousands of machine tools perform their work at a lower cost by reason of their ball or roller bearings. Indeed, the list would be well-nigh endless if every service of these helpful mediums were recited, and the engineer is striving continually to find other ways to utilize them. Panning over the roller bearing for the time, we shall tell here the story of the manufacture of its older brother, the ball bearing.

The use of these bearings has become so general and they can be purchased so readily that the average person looks upon them as a commonplace commonplace and gives little thought to how they are made. To him a sixteenth of an inch is a relatively diminutive measurement, and yet the steel balls for bearings are fashioned to a dimensional precision of a ten-thousandth of an inch. This is essential, for if the assembled spheres in any bearing were not of well-nigh perfect uniformity in size the load upon them would not be evenly distributed, and the larger member of the group would have laid upon it the whole burden and would probably be shattered in consequence, and the same mechanical con-

dition and adherence to precision are essential in turning out upon a commercial scale the rings or races which hold the balls.

Now let us follow through the various stages of the making of ball bearings—starting with the primary raw material. Chrome steel is required for these parts, and while its composition may vary to a degree, it contains generally 1.25 degrees chromium, 1.00 carbon and 0.5 manganese. The metal, when oil-hardened and tempered, has a fine silky grain. None of this steel is saved for working up until it has been subjected to both chemical and physical tests in the plant laboratory, and it is customary to cut from a sample bar a piece one and a half diameters long, and crush it cold to two-thirds of its original length. The metal is not acceptable if it shows any sign of flaw or splitting after this trial.

High-grade balls up to three-eighths inch in diameter are frequently machined directly from rod steel, and for this purpose a form cutter is employed which turns out balls slightly over size. Another method is to machine the "wire" into rings or blanks which then pass on to dies which form them cold into balls having a fine fin around their centers. These balls are next annealed and then run through tumbling machines, each equipped with a pair of case-hardened steel plates, between which the fins are ground away and the little spheres are made ready for rough grinding which trans-

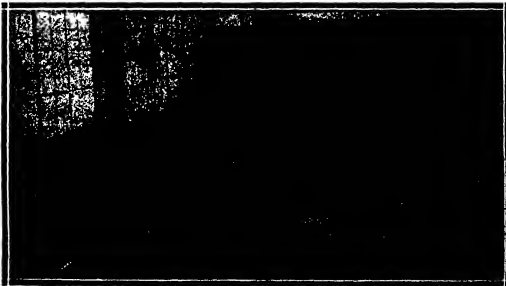
forms them into perfect spheres, slightly over size. The third stage is the best treatment, and this is alike both for the balls produced by the form cutter and those which are manufactured by the dual process of machining and cold forging.

Balls of three-eighths inch and over are usually forged hot by presses equipped with suitable dies, and a sufficient length of rod or wire is used in each case to make a string of from eight to ten spheres at a time. The balls so modeled are approximately spherical and are bound to one another by a thin strip of metal called a "flash." This is afterward sheared and the separated balls are given a rough grinding to remove the flash and to shape them into roundness. In some establishments the practice is to anneal the forged balls in gas-fired furnaces before rough grinding.

The grinding machines, which vary somewhat according to the pattern used, consist in the main of two oppositely rotating horizontal wheels, one which does the grinding. The balls are held in an annular V-shaped groove cut in the center wheel or by a similar runway formed by two guide rings, interposed between the upper and the lower wheels. These wheels are mounted slightly off center to one another, and the result, in combination with the action of the V-shaped groove, is to cause the balls to revolve continuously in opposite directions so that every part of their surfaces is exposed to the abrasive action of the carburettum wheel.

The grinding operation is done dry—the dust being carried off by a suction attachment, and the average machine will treat about a hundred one-half inch balls, for instance, every twenty minutes.

No small part of the acceptability of the ultimately finished ball depends upon the manner in which it is first hardened and then annealed to relieve it of internal stresses. For this purpose the balls are fed into gas-fired furnaces—often designed to rotate, and at uniform intervals groups of the balls flow in for treatment through pipes which shield them the while from the oxidizing action of the furnace atmosphere. After subjected for a suitable period to a temperature of 1,000 degrees Fahrenheit, the balls are automatically discharged



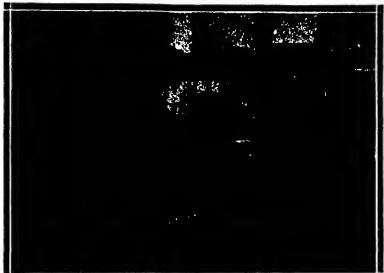
Assembly and inspection department of a well equipped ball-bearing factory

from the furnace and dropped into a bath of oil or water—the choice of fluid depending upon the size of the balls. The depth of the tank is regulated so that the balls will be cold by the time they reach the bottom, whence they are moved by a mechanical conveyor. The furnaces are controlled by electric promoters, which make it possible to hold the temperature at points which experience has proved best suited to each size of ball and to the particular class of steel used for them.

After hardening, the balls are tempered by being heated, according to their size, in oil or water for several hours. While this temperature is relatively low it induces physical changes in the steel, "relaxes" it, and, without affecting the surface hardness, brings about internal readjustments of the metal and puts it in a state to withstand a considerably greater crushing stress. When the balls have been annealed, they are then freed of any attached scale in tumbling barrels within which they are agitated in the presence of a mixture of potash and grit, and this is succeeded by a second barreling operation which, by recourse to potash and a fine abrasive, finishes the surfaces of the balls to a point where they are ready to undergo the finishing test. The manner of making this varies. At some factories ten balls from every batch are crushed successively to destruction in a hydraulic press, and the pressure required to do this in each case is indicated by a gage. Having passed this test, the balls are now given their final finish and polish.

The final grinding may be done either by machines substantially like the rough grinding machines, save that finer grinding wheels are used and the work is done in oil, or apparatus may be employed of the turning type, already referred to. The grinding wheel is forced against the balls at a pressure of from 400 to 800 pounds. The final polish is imparted by two or three "lapping" operations. For this purpose "stones" of fine grade are substituted for the harder cutting wheels and then a leather wheel, with a mixture of crocus and oil, completes this phase of the process. At each point the balls leave the first lapping machine from three to ten thousandths of an inch over size. From the second machine they leave one ten thousandth of an inch over size, and from the last machine they come substantially exact as to size and of a high finish. Glittering as they are, however, there is yet more to be done on them before they acquire the perfect polish demanded in the commercial article.

Following the lapping, the balls are tumbled in a barrel containing soap and a quantity of bits of leather, and when this has continued for many hours the balls are given their final finish in another tumbling barrel, charged with a solution of potash, in which they remain for a period of twenty-four hours. Care has to be taken that this treatment does not go on long enough to spoil the color of the balls by imparting to them a brownish tint. The next step involves rolling the balls about in a third barrel carrying a mixture of leather and mudstone, and this dries and leaves them silvery spheres of wonderful smoothness.



Heat-treating furnaces and quenching tanks in which ball bearings are hardened

While the lapping and tumbling operations are in progress, the balls are from time to time very carefully gaged. The confining gaging, however, does not take place until about 12 hours after the balls are removed from the drying barrel. This allows ample time for them to cool down. In the meantime they are visually inspected for cracks, flaws, or soft spots. Girls are employed for this work, and they show remarkable skill in detecting quickly defects which would scarcely be caught by the untrained eye even when pointed out. The inspection is done in a well-lighted department and each girl, seated at a table, has a shallow tray in which is laid a bottom of glass or a sheet of white paper, the reflected light in either case serving to illumine the underside of the ball so that no imperfection can hide in the shadows. Ten or a dozen balls are thus examined simultaneously. By tilting the tray slightly the balls are induced to roll away from the keen-eyed operator, and the least lack of alertness in a girl will cause it to deviate laterally from the straight path. Defective balls are picked up by magnets or pincers and cast aside, while the remaining ones are dropped into a box for gaging. In some plants the inspectors wear soft chamois gloves, for the least touch of the bare fingers may produce a rust spot. In the course of an eight-hour day a girl expert can examine quite 5,000 half-inch balls, for example.

From the inspection department the balls are sent to a gaging room, where the atmosphere is maintained uniformly at a prescribed temperature, and there the balls are run through machines which automatically classify them into sizes varying by thousandths of an inch. The process consists fundamentally in letting the balls roll down between a pair of slightly spreading metal guides and over a tapered cone, the tapering slot so formed the balls drop successively through openings, corresponding to their diameters, into bins or boxes beneath. Over-sized balls are deposited in

the lowest and last receptacle. The final dimensional test is made by girls who do the gaging by passing the balls through rings or perforated plates, which are accurate within the limits of possible measurement. The operators judge by the sense of touch, *i. e.*, the ease or reluctance with which the balls can be put through the prescribed ring or plate, whether the spheres are acceptable or not.

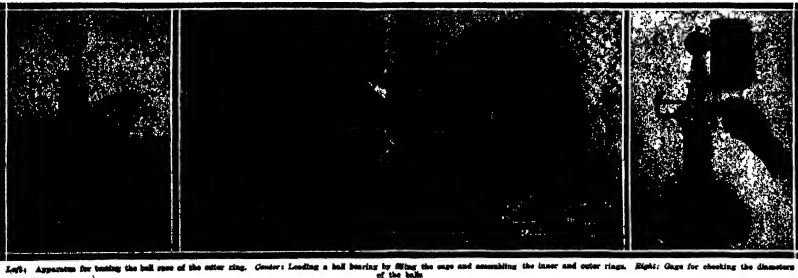
While the guaranteed accuracy of the balls is within the margin just cited, there are factors which produce these steel spheres considerably closer to the stipulated diameter, dimension. For instance, the balls are ground into eight sizes intermediate between the limit sizes, and the difference, therefore, between two such successive groups is only one fifty-thousandth of an inch. All the balls for any one bearing are taken from but one of these groups, and in this way the spheres in a given bearing are as nearly identical as it is logically and mechanically feasible to make them.

No less care is exercised in the manufacture of the races and cages which hold the steel balls of a ball bearing. The inner and outer rings for the larger bearings are machined directly from all-hardened drawn-steel tubing, while the rings for the smaller sizes are cut from solid bars of case-hardened steel—the inner ring being made from the core removed in unrolling the outer ring. Whether tubing or bars be employed, the material is chrome steel.

When the rings have been cut and machined to within eight or twelve thousandths of an inch of their ultimate diameters the bore is bored at each end, and a groove is turned in the ring for the ball-race. With this work done matches are cut between a file and the ball race so that the balls can later on be inserted. Practice in this respect varies in different plants. The rings are now ready to be heated in gas-fired furnaces and then hardened by dropping them into an oil bath. They are next tempered by boiling for a considerable while in water. The tempered rings are tested for hardness and physical integrity by being dropped edge-wise on to a steel anvil. This is called the bounce test, the height of drop and the corresponding height of rebound being different for each size of ring. The examiner determines by the bell-like sound of the dropping ring whether it is perfect or faulty both structurally and as regards hardness.

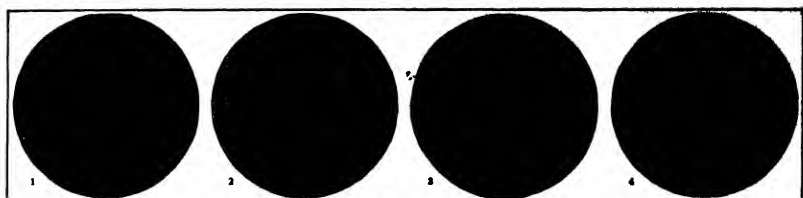
Having passed this test, the rings are ready to be ground to their final size, and this is done with remarkable accuracy. Now comes the still more important step of grinding the ball-race or race, the path of which is of a radius only about 3 per cent greater than that of the balls which run in it. In order that the artifice can do its part to a nicety, its grinding machine is run at a speed which is only slightly in excess of that at which the balls are being ground. This indicates just how the process is progressing. When a ring is thus finished it is subjected to a final inspection which is quite different from the first. The expert training plays its part, and the qualified inspector, usually by employing a scraper, fashioned out of a

(Continued on page 372)



Left: Apparatus for heating the ball case of the outer ring. Center: Loading a ball bearing by fitting the cage and assembling the inner and outer rings. Right: Gages for checking the diameters of the balls.

Putting the balls and the races together into the finished bearing



1. *Urospira*, magnified 125 diameters; this organism causes liver-rot. 2. *Asterionella* (120 diameters); sets regularly spaced odoriferous spheres in the water. This causes the hydrogen and fishy odors. 3. Appearance of *Asterionella* after copper sulfate treatment; note destruction of odoriferous matter. 4. *Synura* (150 diameters); sets thin colonies of cells outside the [fishes'] swimming matter. This organism is responsible for the familiar summer fishy odor.

Three types of micro-organisms whose presence in water gives rise to bad odor and flavor

Keeping Our Water Fit to Drink

Microscopic Denizens of Our Reservoirs, and the Means Used to Keep Them Under Control

By Dr. Frank E. Hale

Chief Chemist Bureau of Water Supply New York City

THE water supply of New York City is based upon approximately fifty reservoirs. Many of these are of extremely large capacity. Ashokan reservoir alone contains 130 million gallons. Another 70 million gallons. Croton Lake 54 million gallons and nine other reservoirs on the Croton watershed range from 3 to 16 million gallons each. The entire Croton watershed with its twelve reservoirs and six lakes has a combined storage of 101 million gallons. Only one large reservoir, Hopkinton, storage extends upon the Long Island watershed. Several distribution reservoirs within the city limits are of nearly a million gallons capacity. The mere handling of such immense quantities of water presents a well-nigh insuperable problem.

The Department of Water Supply has three laboratories and microscopic examinations are made at all three. Every one of its above reservoirs requires examination on a regular schedule not only at one point, but usually at several. In a reservoir with top and bottom draft are sampled at top and bottom and the largest and the most important are sampled at several points. Last year 4,177 microscopic examinations were made. From the standpoint of palatability and of the esthetic character of water supply there is no more important examination than the microscopic analysis. This examination discloses and measures the minute animal and plant life that is present in all surface waters and in some well waters. Large amounts cause an unsightly turbidity and even a relatively small quantity frequently causes complaint because of a scum produced when both tanks are filled with water or of a stain left upon the sides of the white porcelain. The water of swimming-pools is so unattractive that the bathing of swimmers may be affected. For example, the staining of clothes in laundries and interference with the manufacture of correct colors by dye manufacturers and with the drying of goods by the driers. Photographs may also be influenced. The presence of certain types of micro-organisms, or organisms frequently serve to identify the source of a water. The contamination of a well supply by surface water may be indicated by the presence of microscopic organisms.

It is for the most important reason for determining micro-organisms in their connection with disagreeable tastes and odors in water supply. Those so-called littoral growths which are attached to the banks or bottom of reservoirs, and which attract the quaked attention are not concerned as the rule. The trouble is caused by minute floating forms which manufacture essential oils or perfumes like those of flowers. Exceedingly minute amounts produce pleasant aromatic perfumes or grassy odors which become fishy odors pungent or vile in larger amounts or upon decay of the plant growth. Particular species may frequently be identified

by the odor by those who are trained in this work. Three groups of odors are distinguished: aromatic (geranium) caused by distillate grassy caused by camphoraceous and fishy caused by chlorophyllous distillate and proteous. There are in all 22 species which have been known to cause trouble.

In New York City a supply despite the diversity of its sources the only species which have given offense from odors or taste have been *Asterionella*, *Tabellaria*, *Anabaena*, *Aphanizomenon* (with admixture of *Cylindrocapsa*, *Microcystis* and *Oscillatoria*), *Urospira*, *Synura*, *Dinobryon* and *Pordium*.

Asterionella when present in 500 to 1,000 standard units per cubic centimeter produces a slightly aromatic odor. At 1,000 units rarely less the odor is distinctly similar to that of the geranium. The odor increases in intensity with increasing numbers until several tons produce a fishy odor. The fishy odor is also produced when smaller quantities die.

Tabellaria and similarly *Asterionella* in very small amounts produce an earthy odor (also produced by large amounts of *Synura*) passing through the aromatic geranium and fishy stages with about the same relative quantities of organisms as *Asterionella*. At times the odor of *Tabellaria* has suggested illuminating gas.

Anabaena and *Aphanizomenon*, when present in 500 to 1,000 units produce a faintly grassy odor like freshly cut grass. With larger numbers the odor becomes pungent like nasturtium. In large numbers or when decaying, the odor is of the pigpen character.

Synura produces an odor of fishy taste and odor first noticeable in probably 500 to 1,000 units in larger quantities it is very disagreeable the flavor being that of cod liver oil.

Synura may cause trouble apparently in any amount, judging from the recent experience, at least as little as 50 units. The taste is variously described as cucumber, muskmelon, fishy etc. It leaves a bitter after-taste. The after-taste is noted when the undetected organisms are in the drinking supply and in such cases there is but very slight first taste. Water containing the dead organisms has an immediate first taste and practically no after-taste.

Microscopic organisms apparently do not affect the health. Possibly the taste and odor at times produce nausea or distaste for food. It would take 15,000 units of *Asterionella* per cubic centimeter to add a milligram of solid matter to a glass of water, hence the practical impossibility of any chemical effect upon the body.

The first method of control is to shut off the troublesome reservoir and allow it to stand if possible. In three weeks to three months the trouble will usually disappear. This method cannot be employed with certain of the distribution reservoirs, as they are not equipped with a by-pass. The second method is to shift draft from one portion of a reservoir to another if possible, as for instance, from the east basin to the west basin at Ashokan reservoir. The third method is to shift draft from one depth to another. Since 1912, draft at 78 feet depth at Croton Lake has reduced the organisms reaching the city by 75 per cent. Certain forms, particularly the *Cylindrocapsa*, tend to float in the upper water. Probable due to temperature and light, the distillate and proteous stage at times predominate in the upper water.

Both the Ashokan and the Kensico reservoirs have been employed to help remove the taste and odor-producing oils from microscopic organisms. The odor to seaward of the spray is obvious when growths are prevalent. Certain delicate organisms are partially disintegrated, *Urospira*, *Synura*, *Dinobryon*, *Anabaena* and *Asterionella*. It is not the air but the splashing and boiling that produces the effect.

In the recent trouble with *Synura* in New York City's supply and previous experience with *Tabellaria*, it has been learned that chlorine partially kills certain microscopic organisms and sets from the tasteless oils also, by large scale tanks on the watershed, that increased damage with chlorine will destroy the taste and odor in amounts of chlorine not too high for the expense to disappear within a reasonable time, thus not providing loss of chlorine in the water of the supply taps.

The method of widest application in the destruction of microscopic organisms is that of Moore and Keffeler, the application of copper sulfate in its dosage ranging from 0.05 to 1.00 parts per million by weight according to the particular species. The use of copper sulfate is of microscopic organisms by copper sulfate is shown by an immediate disappearance of distillate and fishy odors of the water.

(Continued on page 877)



Chlorostemon plant at the Kensico reservoir of the New York water-supply system

A Midget Wind Tunnel That Works Like a Glass

By the situation and adaptation of compressed air for the testing of airplane models in a special wind tunnel erected expressly for that purpose, the National Advisory Committee for Aeronautics—one of the outstanding organizations of its character in this country—is performing some very valuable work at its Langley Field, Virginia, laboratories where a midget experimental chamber of an unusually small dimensions is now in active use.

The theory of the usefulness of this particular type of tunnel the first of its kind has been the subject of research investigations in this country is based upon the fact that at constant temperature, the density of the air increases in proportion to the absolute pressure. This simply means that a model of a wing tunnel one-twelfth full size where the pressure is maintained at 20 atmospheres provides conditions the same as those that occur where an airplane flies under natural conditions at the same speed as that used in the model tests. This system of testing eliminates all scale corrections and is productive of accurate results. The model used was being used was the novel tunnel was originated and designed by Dr. Max M. Munk while the mechanical equipments were designed by D. L. Bacon.

The tunnel proper is five feet in diameter at the experimental chamber and is enclosed in a cylindrical tank with hemispherical ends. The walls are hollow, providing an air-laid air space in which the balance mechanism is installed. The steel tank is strong enough to stand an internal pressure of 20 atmospheres while it is large enough to provide a return path for the air stream between the walls of the tunnel and the tank. A balance of novel construction is arranged for electrical control either by hand-operated or automatically from outside the tank. These manipulations of the switch attach or release heavy balancing weights by means of special cranes or else they move lighter weights along the balance arms. The airplane model is attached to the balance by means of wires these being three balance arms for measuring the lift drag and pitching moments of the machine. Observations are taken through glass holes in the shell of the tank. The tank is inflated by two electric air compressors.

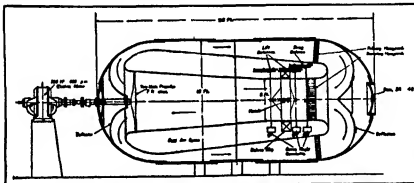
The steel tank mounted on a concrete foundation and partially surrounded by a working platform is 35 feet long, 15 feet in diameter and weighs about 85 tons. An observer who is stationed on the platform makes settings and readings by looking into the tank through the small peep holes. The cast steel door that provides access to the curved tank chamber is at one end while the drive shaft for turning the propeller passes through the shell at the opposite end. The tunnel proper is made of wood, cylindrical at the experimental chamber with conical approach and exit sections supported within the tank by a structural steel frame. Trumpet shaped deflectors made of sheet metal are fitted into the tank at either end to assist in maintaining a smooth flow of air from the inner to the outer chamber and vice versa.

Circulation of the air is effected by a two-blade propeller seven feet in diameter located in the outer end of the exit cone and driven at a speed of 900 revolutions a minute. A 250-horsepower motor mounted on a concrete base at the end of the tank drives the propeller through a single coupling. This drive shaft is made light by means of air bearings where it passes through the head of the tank by a loosely fitting gland through which oil is circulated. The oil does not leak out of the gland, oil is pumped into the gland at intervals by hand and is returned after use to the reservoir by a special motor-driven pump.



Compressed-air wind-tunnel at Langley Field, showing observation platform and air compressor

When operating at its greatest density the new Langley Field air tunnel is equivalent in scale to a tunnel 100 feet in diameter running at 60 miles an hour. The tank can be inflated to 20 atmospheres in one and one-half hours by means of the two compressors. A primary compressor driven by a 200-horsepower motor is used to provide pressure conditions that range from one to eight atmospheres. If greater pressure is desired a secondary or booster compressor is also pumped for the



Vertical longitudinal section of Langley Field's midget wind-tunnel

tion, it being driven by a 140-horsepower induction motor. The information obtained from the wind tunnel tests that are made at Langley Field can be directly applied by the designers at the drawing boards who are working on new types of airplane models.

It is interesting to note this illustrative air tunnel set up with the huge 1-inch wind tunnel described in our August, 1922 issue. The French air tunnel has a wind tunnel 10 feet in diameter and a fan which

selection can be obtained from the Superintendent of Documents Government Printing Office Washington, D. C. at 10 cents per copy.

A 25-Ton Portable Riveter

IN connection with the Niagara fall power development the construction of the 70,000-horsepower turbine, together with the penstock. The size of this assembly is enormous. The size of this assembly is enormous. The size of this assembly is enormous.

These demands have been met by the design and construction of a huge machine illustrated on our cover this month. The total portable weight of this riveter is of 750 pounds and against 25,000 pounds for its largest portable predecessor. The frame is a single steel casting weighing 15,000 pounds the additional weight resides in the spindle and the riveting mechanism.

The suspension beam (at top) the two vertical lines the spindle housing and the spindle frame a parallelogram with (vertical support) at the crane hook directly above the center of gravity of the entire machine. The machine is supported by two lugs and the inertia alone have to be overcome in lifting the riveting jaws from one point on the work to another and the motor (of 1/2 horsepower each are actually sufficient for the job). The tilting motion is limited to 30 degrees below the horizontal but the rotation can be carried through the complete circle.

Wired Wireless Broadcasting

THE "Wired Wireless" recently given the first demonstration of commercial wired wireless broadcasting as applied to electric light wires on Times Square, New York City. The studio is not unlike the usual radio studio. The output instead of going to an aerial and ground connection is delivered to the electric wires passing by the studio.

The wired wireless broadcasting company is planning an 18-hour daily program electric light users can subscribe for the service in which case they are furnished with a compact receiving set which is attached to any electric light socket or outlet by means of the conventional plug. The lowest subscription rate provides for a crystal set and head phones while the highest rate provides for a loud speaker set. If the Staten Island installation works out successfully both technically and commercially the idea will eventually be extended to other electric light systems.

The world's largest portable riveter, whose design was accomplished by the machine job for the Niagara power development

Shifting Speeds With An Oil Pump

Some Details of a New British Variable-Speed Gear Without Gear-Wheels

By P. J. Riddon

ALTHOUGH this system of what may be termed "gearless gearing" has been in use for some years for such purposes as elevating naval guns and for the steering gear of ships, its application for other purposes has been neglected. At present, however, experiments are being conducted in England with a view to its application to automobiles. If these experiments are successful the outcome will be a revolution in the design of road vehicles. The subject is therefore of such great and direct interest to all car owners that we shall endeavor to treat it in as untechnical a manner as possible for the benefit of those who are not engineers.

Supposing we have a vertical pin or hub on which a ball-bearing like-wheel is mounted. If the wheel is horizontal there is no tendency for it to rotate, but if we tilt the assembly to a sufficient angle the more weight of the tire valve will be sufficient to cause the wheel round until at last it will stop with the valve at the bottom of the slope. Now suppose that there is no valve and that the wheel is perfectly balanced. If we then place a weight near the top of the slope, or impart a purely vertical pressure, the wheel will move round. More generally, if a pressure be imparted at right angles to the plane of a balanced wheel or disk in any position, no movement takes place, but if we impart the pressure of an angle to the plane and if friction be eliminated or reduced sufficiently, we cause it to rotate.

The gear that utilizes this principle comprises essentially two units. One of these consists of a special design of multi-cylinder pump for pumping oil. The other consists of one or more motors driven by oil delivered under pressure by the pump. The pump and motor may be placed at any convenient distance (within reasonable limits) from each other and at any angle or different height, and the two connected by a pair of pipes for the flow and return of oil. Alternatively the motor casing may be bolted direct to that of the pump casing so as to constitute a double unit, with the driving and the driven shaft in alignment. The only difference is that in cases where the two units are separated, there is a valve plate on one end of each, to which the ends of the two oil pipes are coupled. We describe the direct-connected type.

The pump is housed in an oil tight case and comprises a thick mild cylinder called the "barrel" in which nine holes are bored horizontally, that it looks something like a large revolver barrel. The holes are not bored right through the barrel, but from the dead end of each a similar hole is bored connecting the larger holes with oval-shaped ports in the other end of the barrel. The barrel itself is keyed on the driving shaft and rotates with it. A set of pistons works in the cylindrical barrel holes and these pistons are coupled

to what is known as a "socket ring" by connecting rods with cup and ball connections so as to allow of a certain amount of play, the necessity for which will be seen later. The pistons are hollow, and as the system is charged with oil constantly circulating under high pressure, the spherical bearings are always well lubricated. The socket ring is secured on the driving shaft by means of a universal joint, so that it is free to rotate relative to the pump ring rotates with it. The socket ring bears upon a set of circumferential rollers within a cup-shaped housing, the end thrust being taken by a separate set of conical thrust rollers.

The housing is mounted inside the pump casing on a pair of transoms, a vertical shaft and worm engaging the housing (and with it the socket ring) to be tilted to an angle of about one in two and one-half on either side of a plane normal to the shaft. Between the pump and motor barrels is a gunmetal valve plate with a pair of curved ports right through it. The center of this valve plate is bored and hinged to receive two sets of roller bearings on the ends of the pump and motor shafts. A hole drilled through the valve plate enables oil to pass from the outer pump casing to the outer motor casing, the flow being maintained on an equal supply of oil in each.

When charging the system, oil is admitted to the casing from a reservoir and the pump is run for a short time. Any imprisoned air is then released by means of air pipes which are replaced. The reservoir is then replenished, the pump is run again and any re-



The gear with the outer casing removed, showing pump and motor complete

maining air is released by air valves on the valve plate. The gear is then ready for work.

Let us now suppose the parts to be assembled within the casing, that the system is full of oil, that the pump shaft is coupled to a suitable prime mover such as an electric motor or an engine, and the oil motor shaft to another shaft that has to be driven. It is important to remember that the pump and motor shafts are in no way connected, but are free to rotate at different speeds. If the pump socket ring be first actuated by the worm or by a tilting mechanism at right angles to the axis of the shaft, and the engine be then started and run at full speed, the socket ring and pump will merely rotate without any pumping action.

As the pump shaft is connected to a prime mover, taking place and consequently without affecting the motor at all, so that the motor shaft will remain stationary. But if we gradually tilt the pump socket ring in either direction it will be forced to rotate in the plane in which it lies by the housing containing it. If the universal joints permitting of this. Consequently it will cause the pistons to move in and out of the barrel cylinders, so that during half a revolution oil will be pumped out of the cylinders, and during the other half revolution oil will be sucked into the same cylinders. The oil must necessarily pass through the valve plate ports to the motor, on the pistons of which it will produce a corresponding movement. But the motor wheel being permanently set at an angle, when the pistons are forced on the pressure on the

inclined ring causes it to rotate. Thus the oil is constantly circulated between the pump and motor under hydraulic pressure and serves as the working fluid. The pressure tilts the pump socket ring, the more rapid the flow of oil and the more rapidly the motor shaft rotates.

In a set of gear tested by the writer an electric motor was coupled to the pump shaft and run at a thousand revolutions a minute. The pump socket ring was then slightly tilted and the motor shaft ran at one revolution a minute. From this, by increasing the tilt, the motor shaft was speeded up to a thousand. The socket ring was then tilted in the other direction, the speed of the motor shaft gradually slackened down to zero, and the same procedure was gone through with in reverse.

An efficiency of 85 per cent is obtained at full-speed transmission. This efficiency drops slightly down to half speed, and then more rapidly at lower speeds.

It will be clear from what has been said that, if we couple the pump shaft to an engine shaft, and the motor shaft to any other shaft that has to be driven, the variable speed gear provides a neutral position and also enables any desired speed in either direction, from zero to maximum speed, to be maintained, according to the load. It has already been explained that the pump and motor units may be placed in any convenient position and connected by a pair of oil pipes that virtually take the place of shafting. It is obvious then that the gear is eminently suitable for use with alternating electric motors for which elaborate means have to be provided to enable them gradually to take up the load. Again, it should often obviate the necessity for the totally enclosed type of electric motor, necessitated in certain cases by the fact that motors have to be coupled up to the machines they drive. With the variable speed gear the electric motor and pump can be placed in any convenient position and the oil motor in any exposed position desired.

Another of its uses is as a hydraulic pump. A section pipe from a reservoir to the pump unit would keep it filled and sealed, and it could be used as a variable speed pump for hydraulic work generally, its output being automatically controlled if required.

But of all uses its application to automobiles appears to be most useful. Let us consider why. Firstly on an ordinary motor car we have the clutch-at least a crude apparatus. Secondly there is the gear box, with its arbitrary steps in speed, that require skill and practice to manipulate properly and without ear-splitting noises as when the gears refuse to mesh under the hands of a beginner or an unskilful person. Thirdly there is the clutch shaft and a number of universal joints requiring frequent attention. Fourthly there is the clutch-shaft brake with its attendant levers. Finally there is the back-spring gear and differential. What can be said of a device that will eliminate all the above-mentioned objectionable features in automobiles? For that is what the experiments lead the machine confidently to anticipate.

A pump unit will be coupled direct to the rear end of the engine shaft, a pair of motor units will be placed in alignment at the back axle, with oil pipes between them, and the pump unit, and each oil-motor will drive its own wheel shaft. In the case of differential gears, instead of differential.

(Continued on page 276)

The valve plate between the pump and motor units

Application of the gear to an electrically-driven capstan

The socket ring of the new gear

Clever Contrivances of the Garage Man

ALL specialized trades in which the machine figure at all present scope for the inventor to provide special tools and fixtures for doing very special jobs in a fraction of the time that would be required were those tasks to be performed on stand and lathes, drills, or other apparatus. In no other line has this tendency gone farther than in automotive construction and repair work, and in no other are the devices of the sort suggested in wider or more general use. That the factory would have gone in rather heavily for this sort of thing is far from surprising, but that the garage man has done so and does afford such a variety of special equipment would be a surprise to one who had not clearly visualized the enormous saving in cost which enables a machine to pay for itself despite that it is used but once or twice a day.

A San Francisco garage was invaded by the *SCIENTIFIC AMERICAN* correspondent some time ago, and at least three machines found which earned the attention of the reporter and the reporter's camera. The first member of the group below is a stand for testing and adjusting differentials. This clever outfit is so arranged that it gives information about the differential which, in its absence, could be got only by repeated road trials of the car, with dismounting and readjustment of the rear end between every two trips. At the right is seen the variable-speed motor that drives the differential undergoing test. At the extreme lower left is seen the foot-lever for the proxy brake which applies a retarding force to one side of the differential, and enables the operator to watch the complicated gearing in action. Not alone in working conditions, but in the absolute satisfaction with which differential adjustments may be made, this assembly is of extraordinary value.

Every owner has, at one time or another, had electric trouble of a nature requiring the setting out of one or more of the circuits on his car. Sometimes this has entailed an actual dismounting of portions of the car and carrying of them indoors to the testing apparatus, at best it has involved a good deal of inconvenience in bringing the testing apparatus to the car. Here we have the better way. A battery is mounted in a wheeled box (the wheels may be just made out, where they peep from under the edge). In addition to the wheels, the box carries on its under side a cradle making it easy to set it down on the framework of the car, or anywhere else for that matter. The lead wires of the battery actually serve as "rod", the mechanic drags the battery about by them, and in a jiffy he has it right at the spot where its aid is required to learn the electrical condition of the car.

The third view shows the portable tool racks which follow out more or less the same line as does the portable battery. Each of these stands has three racks, enabling it to carry practically all the hand tools likely to be required on any repair job. They wheel about



This circular computer is presented as an improvement upon the conventional slide-rule

from place to place, so that the busy mechanic always has his tool kit at his elbow, and is able to dispense with repeated trips to the other side of the building to get them.

The mine garage has a clever way of testing head-lights for conformity with the law—which must be more strictly enforced in California than it is in the average eastern state. If any necessity is ever felt for checking up a car's compliance with it. On one end of the building have been painted a series of vertical and horizontal lines, with two dots. The vertical line is in the correct position for centering the automobile whose lights are under examination. The two dots are then in such place as to correspond to the exact center of the lamps. The line on the floor marks the distance from the wall which the lamps should be for the test, and the horizontal mark on the wall indicates the dead line above which no light from the lamp should fall. This is sufficiently clear without a photograph, and equally clear it is, that with the lines properly arranged the assurance may be had that any lamp meeting the above conditions meets the state law.

A Circular Slide-Rule

ALL technical calculations require answers to an accuracy consistent with the data 2, 3, 4, or in very few cases, 5 significant places. For this purpose the graphic method is by far the best. But the shrinkage and warpage of the ordinary wood-venetted slide-rule, make it unreliable, while its scales require months to master. A new, all-metal, circular computer that utilizes the logarithmic principle, but is built into a transit or compass, and convertible for desk or pocket, has been recently perfected by Louis Ross, a civil engineer and ingenious inventor of San Francisco.

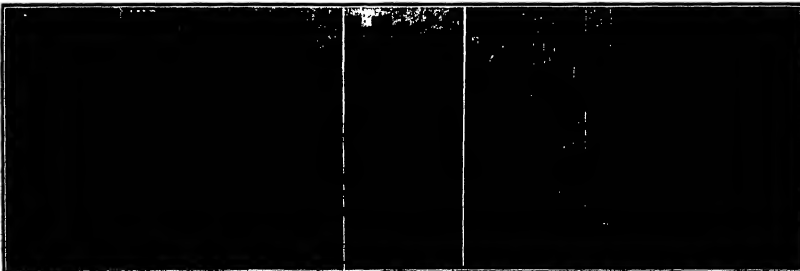
This computer is shown in the illustration. It consists of two scaled, rotating dials, read by a radial hair-line engraved under the lockable arm. The computer is five inches in diameter, while the inner dial is four inches, so that contact scales are 19/16 inches long, like upper scales of a 25-inch straight rule. The outer and inner dials of the computer are analogous to the upper and lower movements of an engineer's transit, a thumb-lock, as on a transit, controls the outer dial, while a special device, leaving other hand free for writing down results, insures readings, answer and proof, like the double verniers on a transit, eliminates mistakes and errors, instrumental and personal. The dials are graduated directly on heavy metal, fine as a transit, but in purple color easy to read and soft to the eye. Made wholly of metal, the computer is unaffected by heat, cold, dampness.

The magnifier, adjustable in focus, radius and direction, makes readings appear larger than ordinary typewriting, increasing accuracy of interpolations. When direct, less precise readings are desired, a touch of the finger turns the magnifier aside, and it is instantly detachable for separate use. The use of either magnifier or dew-clamp is optional, both are instantly detachable. The loose-leaf leather case, supplied with standards 5% x 4% sheets, in a variety of rulings and forms, folds to 5 x 7, so as to fit coat, breast or back pockets.

The key for operation is given on the arm, in plain sight of user. When any problem is set under the hair-line of the arm, a long arrow automatically points to the answer, while a short arrow shows the proof. If the problem involves three items, two knowns are set opposite each other, and opposite the third known the answer appears. Result numbers, or "constants," can be locked, so that they will not shift accidentally—a great convenience in heavy, tabular work. Trigonometric, logarithmic and exponential problems are solved just like plain numbers, by using the special scales as labelled on the arm, for that purpose.

State Trade in Foreign Countries

FOR the benefit of American coverage exporters, the Lumber Division has just issued the publication "State Trade in Foreign Countries." This is a compilation of reports from American consuls and representatives of the Department of Commerce in various foreign countries. Being replies to a questionnaire sent out by the division, these reports cover the importation, domestic manufacture, specifications, and uses of copper, as well as indicate how the import trade is handled. In addition, statistics on the coverage exports of the United States and imports and exports of other countries were prepared by the division. Statistics on United States exports for 1922, which were only recently available, have been added as an appendix.



Left, fixed and motor for giving the differential a test which otherwise would have to be made on the road. Center, Battery arranged for maximum ease of portability in connection with electrical tests of the car. Right, ingenious device that has its use in place for both. Some of the ingenious special fixtures with which the labor item is cut in the up-to-date garage

Feeding the Automobile Engine

Purdue University Investigation of the Proper Treatment of Mixture that Goes to Carburetor

THE FUEL problem is no longer merely that of finding a supply of light combustible hydrocarbons. It is that of an assured supply of any liquid fuel at a proper price. The public has ceased to ask for light and volatile fuels, and is asking merely ordinary combustibility and a reasonable cost.

We are told that we are to have in ten years a supply of gasoline. The situation is not quite so desperate as this, for we shall undoubtedly develop new sources and new fuels. But in view of all the known factors, it is necessary to conserve fuel and to utilize fuel with a minimum of wastage.

Our truck and tractor must today use the heavier fuels and leave the lighter ones for the plane. These heavy fuels grow heavier each year, they continue to burn in our cars, but with a long tale of low efficiency, excessive repairs and maintenance, and short life. We sometimes ask whether the Otto cycle is permanently suited to the fuels of today and tomorrow.

The Otto cycle may ultimately be replaced, but for the present it is the one in universal automotive use. The immediate attack upon the fuel problem lies in the practical use of all available data regarding fuel car combustion. Formerly the light fuels required no heat beyond the sensible heat of the intake air. Today, even with decreased manifold pressure, the atmospheric temperature is inadequate and heat must be added. Much hinges about the best way of effecting this addition, six different procedures may be identified.

Preheating the fuel for the sake of a dry mixture is useless, it interferes with inverting at the nozzle. Moreover, what is needed is the heat equivalent of vaporization, after the boiling point is reached, and in no event can we raise the temperature of the fuel above the boiling point of the highest fraction.

Preheating the air is very useful on the cars now in operation. It does not interfere with carburetion but cuts down volumetric efficiency and power delivered. It gives good mileage, smooth running, elimination of all dirt, less mixtures with freedom from carbon deposit. The main objection is the decreased power output and the slight decrease in thermal efficiency at the higher temperatures.

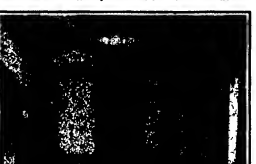
The advantages of preheating the fuel and the air are principally those derivable from heating the air alone. Again the fuel must stay below the boiling point of its lightest fraction. No heating of the fuel is advisable beyond that which necessarily occurs from the heated air, unless a device is used that is peculiarly adapted to metering control.

From the theoretical viewpoint, heating the mixture has advantage over the reduction of atmospheric pressure, and the degree of heat may be more variable without affecting the carburetor. If the minimum temperature is sufficient for idling, the maximum will not cause bad effects at higher loads and speeds. If skill is not exercised in the design and placing of the heating surfaces, however, the power loss is as great as with the preheated air method.

Heating the fuel after metering is more costly the ideal method, possessing the good points of heating the mixture and being free of the bad features of the other ones. Having been met, the fuel may be completely vaporized if necessary. The temperature of the vaporizing surfaces, when exhaust heat is used, never raises the fuel. The air is heavily heated at all, while the fuel is only vaporized. When the two are brought together, the temperature of the final mixture approximates closely to the theoretical minimum, so the power loss is insignificant. Again care must be exercised in the design and wet portions of the fuel must be allowed to pass through the separating device or acceleration will be accomplished only with a lag.

Heating the fuel and part of the air after metering is a modification now in use in some cases. The final temperature of the mixture may be quite low without excessive deposition. A very delicate metering device must be used, however, and no vaporization entirely from the heated walls of the hot areas, the temperature of these must be very high.

The Engineering Experiment Station of Purdue Uni-



The fuel is weighed on the balance and weighed from burner to carburetor. The panel at the left provides electrical means for controlling measurement of speed, time, air and fuel. The switchboard at the bottom provides means for variable voltage from 2 to 22 volts, electric facilities of service.

The details of the control table

versity has made extensive tests to show the relative merits of preheated air and of the various hot-spot methods which comprise the alternatives, as well as to bring out all possible data regarding fuel preparation and combustion, fuel-air ratios, etc. The accompanying illustrations show in some detail the apparatus used.



The engine, air-heater, air-meter and control apparatus for the carburetion tests described herewith

In these tests, The engine was direct-connected to an electric crane dynamometer through a suitable universal joint. Means were provided for measuring all temperatures, pressures, etc., and all tests which were to be compared in any series were made with the same throttle opening and load. In testing the "hot-spot" operations the hot spot was of experimental design,

heating at the outside bend of an enlarged intake pipe. An inspection glass of simple diameter was placed at the top of this section, so that the spray could be easily observed, and the dynamics of the mixture and the aim of the fuel glasses noted.

In general terms, these tests showed that with suitable attention to the best operation of our automobiles and trucks it is possible to save the fuel now used in the automotive industry could be conserved. This would come to 1,962,000,000 gallons, worth, at current prices, some \$300,000,000. This estimate is conservative, it represents the minimum saving which might be effected with the vehicles now in use. With accurate data on the numbers, types and weights of these, the saving would no doubt work out at a higher figure.

It is not alone the fuel that is wasted, but this loss indirectly leads to other complications. Poorly and partly burned fuel causes dilution, excessive carbon, and hence high upkicks and high depreciation. The unnecessary charge under these headings for the entire United States is at least a billion dollars annually. Applying the results of these tests to individual cars, substitution of correct for incorrect operation has in numerous specific cases increased fuel-mileage anywhere from 40 to 250 per cent. It is believed that at least half of the cars now operating are susceptible of material improvement in fuel utilization.

In support of their conclusions that the hot-spot method affords the best prospect of meeting future conditions, the Iowa engineers refer to the fact that while there has been substantial conserving of the power loss due to excessive heating of the charge in a vaporizing manifold, low efficiencies have been obtained, and that as much or more power loss is possible from the decrease in volumetric efficiency that follows from poor selection of heating surfaces and from the high temperatures of these surfaces. With the very crude experimental hot-spot used in the tests, a metal temperature of 580 degrees at the hot-spot gave a dry mixture at half load with an intake pressure of 11 inches of mercury. Why, then, cannot the performance be satisfactory at low speed idling with a metal temperature of 800 degrees and 20 inches of vacuum? The problem of manifold design resolves itself into the one of finding a manifold design resolves itself into the one of finding temperatures, temperatures available from the exhaust at all operating conditions, and the vaporization of the fuel in its relation to distribution to the several cylinders, and the utilization of ingenuity in the design of the vaporizing surfaces. If any analytical methods were substituted for the out-and-out procedure so largely in use heretofore, some of these problems would not assume such large proportions.

Engineers concede that the fuel of the future will be better than that of today. This granted, the statement can be made that mankind will still manufacture vapors and distribute the mixture as well as for some time, or better. The big handicap now and in the future is the starting. When a starting device is used that will immediately deliver the mixture sufficiently dry to the cylinder, no approximation need be felt with regard to the good performance of the engine after it is warmed.

Street Lighting

THE Bureau of Standards is making a study of the various systems of street lighting used in cities and towns throughout the country. Seven hundred and forty-four municipalities have been asked for copies of their street-lighting contracts, and 152 replies have been received so far. About 500 replies have been received on the subject of street-lighting contracts. The test of a number of the present systems of a circular on street-lighting service has been prepared in preliminary form.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News



This attachment to the knife enables the hostess to serve the cake in complete safety.

A Novel Cake-Server

INVENTION has come to the rescue of the host or hostess whose lot it is to cut and serve the layer cake. No special tool for this purpose is offered, but rather an attachment for the ordinary knife. This attachment, much like a two-bladed fork in general outline, slips around the handle of a regular dinner knife. When the cake has been cut, the knife is slipped under it, and the fork pushed into the cake, holding it securely on the knife blade.

Oxidized Kerosene as Truck Fuel

THE solution of still another industrial problem has been undertaken at the research laboratories of Carnegie Institute of Technology, Pittsburgh, in experiments to determine the relative efficiency of kerosene and oxidized kerosene as fuels. In accordance with the policy of the institute to link up its educational facilities with modern industry, the Department of Chemical Engineering has been conducting a series of tests to determine the relative merits of various oils as viable fuels. The completion of this important work should go a long way toward solving the problem of oil conservation by the possible development of a new fuel. According to a report by Dr. J. H. James, head of the department conducting the experiments, oxidized kerosene causes less "knocking" tendencies than straight kerosene when used in a kerosene engine. The tests also showed that oxidized kerosene has approximately the same power development as ordinary kerosene in spite of the fact that their thermal value is one-eighth

less. Dr. James attributes the efficiency of the oxidized kerosene to the better "even up" in the combustion of these partially oxidized fuels. The success of the experimental work at Carnegie at this stage gives promise that oxidized kerosene, which is manufactured by catalytic oxidation from low grade petroleum, may become a useful fuel in the future. Its properties may cause it to be used industrially in kerosene engines or blended with gasoline for use in aviation engines. Although it has a somewhat lower fuel value than ordinary kerosene, one of the most favorable features of its effectiveness is that it undergoes much better combustion in the internal combustion engine.

A Heat Economy

IN the advances of recent years in the manufacture of cement is of greater importance or interest than the utilization of the hot gases escaping from the kilns to heat the boilers that supply steam for the operation of the cement-plant powerhouses. For years an immense amount of energy was lost in these gases, which reached the stack at temperatures of ten to fourteen hundred degrees Fahrenheit in plants using the dry process of manufacture.

Many problems stood in the way of utilizing this heat, but great progress has been made, with the result that a number of plants are now producing from 50 to 100 per cent of their power requirements through waste-heat boilers. Such installations require heavy expenditures, but the adoption of this means of saving fuel will undoubtedly become more general as time goes on.

These waste gases consist largely of nitrogen from the air that furnished oxygen for combustion in the kilns and of carbon dioxide driven out of the lime stone during the burning. In plants employing the wet process, waste-heat boilers have been installed and have realized in important savings.

Magnetic Assaying

THIS device is used for quickly reducing a sample of ore so that the magnetic iron percentage can be accurately computed. A sample of ore is placed in the glass tube which has been previously filled with water. The cartridge and tube are then automatically rocked, the cartridge bearings being placed at the poles of the magnet. A stream of water passes through the tube, washing away the tailings from the concentrate, which is held at the poles. When the washing is completed, the magnetic assay is made.

Device for determining the amount of magnetic ore in concentrate.

The Latest Auto Lock

HERBETLIIH is illustrated one of the latest devices for deterring the automobile thief. It consists, as the letters indicate, in a simple lock that is attached to the steering column, beneath the wheel. When locked two plungers project upward and firmly hold a spoke of the steering wheel between them. The lock and plungers are of drop forged, case hardened steel, brashly nickel-plated, the lock itself is a cylinder affair of the familiar model. The lock is so constructed that it will not rattle, and there is no danger of its falling into locked position while the car is running.



By means of projecting plungers that engage a spoke of the wheel, this lock makes the car secure.

A Magnetometric Method of Determining Carbon in Steel

AN interesting account of a magnetometric method for determining carbon in steel was presented by Gunnar Malinberg at the recent annual meeting of the Swedish Metallurgical Society. The new method is based on the fact that the magnetic properties of steel undergo a striking change as the percentage of carbon is altered. Though even other components of the alloy exert an effect of their own, this is, as a rule, incomparably smaller and, accordingly, does not greatly affect results. Moreover, as much as Mr. Malinberg has accurately studied this effect, it is readily accounted for. An apparatus designed by the experimenter and known as carbonometer enables this method to be applied to the testing of steel samples in actual practice and, being both rapid and reliable in working, has been adopted by some of the leading Swedish iron works for checking the progress of steel refining.

Soldering Without a Soldering Iron

SOLDERING without the use of a "copper" produces neat and rapid results, says *Skott's Metal Worker*. The method is to heat the parts to be soldered, by means of a torch flame, until they are just hot enough to "sweat." In this condition, but not enough to burn, the solder runs off. The ability to get the correct temperature comes with practice. A small, compressed flame is best. Wire solder is employed, with the usual flux, and an acid brush. The surface to be soldered should be kept horizontal.

If jobs of solder form, they may be wiped smooth with the acid brush and the surface heated again, but when skill is acquired, the brush can be dispensed with altogether. No welding cloth is needed. The only drawback to the method is that considerable practice is

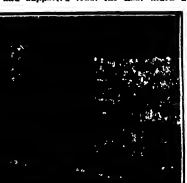
Wood Poles for Transmission Lines

A GERMAN firm has lately put on the market a type of wood pole, which should have a life of at least 40 years. The upper portion is of the usual kind while the base is of impregnated hard wood. Experience shows that impregnated beech wood will permit of life exceeding 30 years, and as poles are not subjected to the same mechanical shocks, the makers anticipate a longer life than this for their poles. The two portions of the pole are bound together by wrought-iron strips, which are bolted together.

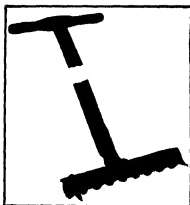
The Window Bed

NO longer is it necessary to provide an expensive sleeping-porch for the benefit of those who need fresh air at night.

The window bed here illustrated can be rolled out of any window, with perfect safety. It is in reality a completely erected cot, mounted on a metal frame and supported from the floor much as



Sleeping out of doors without a sleeping porch.



The simplified lawn-mower

small iron beds are supported when rolled on its frame out of the window, it is held in place by chains. For camping the bed like frame is not used, the springs resting upon the supports that hold them to the frame of the house. Under such circumstances, the sleeper is about six inches from the ground.

Keeping the Kitchen Range Bright and Shiny

POLISHING the kitchen range is not so essential as keeping it oiled against the invasion of rust. This fountain brush cleans and oils at the same time the flow of oil being adjustable from the oil container which is in the top of the holder. A slight pressure of the thumb on the plunger, as illustrated, gives regulation to the precise amount of oil desired.

Funnel, Filter and Dipper in One

THREE kitchen utilities in one is a convenience now offered the house-keeper whose space is limited. Funnel, filter and dipper are consolidated into a single tool illustrated doing duty as a funnel. For conversation into filter or dipper the circular attachments are used which in the photograph are shown locking against the bottle. Two of these are of wire a reamer one coarse-meshed and one fine when placed at the entrance to the tapering part of the funnel, they obviously convert it into a filter. And when it is to be used as a dipper the solid ring is used in their stead, and the contents of the bowl instead of running through, stay in.



The insertion of one of the circular plugs converts this funnel into a filter or a dipper.

A Simple and More Compact Lawn-Mower

ABSOLUTELY simplified lawn mower has been recently introduced by a Michigan manufacturer. It is claimed that the device cuts and trims both tall and short grass at the same time. It is lighter in construction than the average lawn mower, weighing only seven pounds. Because of the fact that there are no large wheels at the side, it is possible to cut grass around trees, shrubbery and along embankments much better than formerly and this eliminates the necessity of hand cutting and trimming.

The mower differs in much the same manner as other types, having a long T shaped handle which is solely set. The cutters consist of sixteen small grass-sharpened wheels but sharpened. Eight cutters on a side interlock and insure that the grass is cut evenly wherever



Convenient device for cleaning and oiling the kitchen range

the mower is guided. The cutters are adjustable so that the grass may be cut to any desired height. At the sides are two small wheels, only two inches in diameter. These serve to guide the mower and take the place of the large wheels used on other types of mowers. These wheels have geared tooth edges which secure a hold for the mower in the dirt. Just in front of the wheels are two rounds with pointed ends which serve to guide the operator of the mower and insure that it will be held at the right angle so not to beat results. The cutters do not need sharpening, but can be replaced at a small cost.

Solving a Printing Problem in the Composing Room

TYPICAL of a certain printing problem that often arises is the conventional check-book of large size, with three checks on a page. It has always given the printer the option of setting up the check three times or of printing three impressions upon the sheet, one after another, from the single plate. The first alternative is obviously an expensive one; the second introduces the further complication of getting the second and third impressions in exact register.

A noted inventor of Port Worth, Tex., K. J. Dullafante, has secured a successful corner between Scylla and Charybdis in the kind of a compound "change" in this word, we should explain to the uninitiated, standing for the postal frame in which the compositor lodges his type before sending it to the press. Mr. Dullafante's device consists of an entire frame and at least one. The outer case is merely as a truck for the inner one to move in. The inner one carries the type, which is set just once for the three (or more) impressions. The inner chase is mounted in thin strips, so that the pressman, as pulled that new complete

turn corresponds to a spacing of one piece. Thus it becomes possible, after a slight impression has been run off with the inner chase in its upper position, to lower it down to an intermediate position and run the sheets through again for the second check, without a thought for the problem of register, which is now solved automatically. And in the same way, the inner chase is screwed down all the way for the third and bottom most impression.

We have described its operation only for the case where three identical impressions are to be made, but obviously the chase can be built for any desired number.

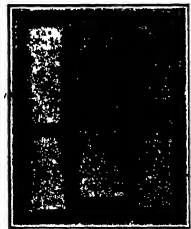
The Circular Washboard

KITCHENETTE housekeeping is brought one step nearer the ultimate goal of simplicity by the washing outfit illustrated. The washboard is made circular in section, and a peil approximates of corresponding radius. For washing the two are fitted together as in our illustration for storage or packing they are left that way, and when the bucket is needed as a bucket, the washboard comes out. With the aid of this combination and a chair, one washes with convenience equivalent to that given by the stationary washbub.

Photography Makes Charged Manuscript Legible

AN important discovery, which practically solves the problem of restoring writing or printed records made illegible by the carbonizing effect of heat under partial exclusion of air, has recently been made by M. R. Davis, one of the research workers of the Bureau of Weights and Measures in Washington, D. C.

Manuscripts, typewritten and printed



The adjustable, three-positioned case that cuts the case of printing checks, three on a page.

sheets of paper were used in the experiments. They were subjected to conditions similar to those to which documents enclosed in fireproof safes are exposed during a big fire. Enclosed in a nearly airtight container of fireproof material, these papers were subjected to a high temperature until they were carbonized. When removed from the container, the papers were completely charred and neither the writing nor the printing could be deciphered.

Mr. Davis, placing one of the carbonized sheets between two photographic plates and leaving them undisturbed in darkness for two weeks, obtained clear and perfectly legible negatives of the writing and printing on both sides of the paper. The plates showed nothing in the previous of the writing on the sides of the paper with which they had been in direct contact and, very faintly, traces of the



A space-saving wash-day combination for the crowded apartment

writing on the reverse side. Rapid and medium plates gave the best results, while slow plates gave poor results.

When rapid films were used instead of plates, the results were even more satisfactory. Excellent reproductions were obtained after an exposure in the dark-room for eight days. Strangely to say, the writing and printing appeared on the films black, like a positive. It was learned that with films also negative could be obtained, if before exposure, the carbonized sheets were carefully washed with distilled water and dried.

It is believed that the effect on the sensitive coating of the plates or films is due to the gases contained in the carbonized paper and that the written or printed characters on the paper appear in negative because the ink acts as a screen, preventing the reducing gases from acting on the silver emulsion.

The Flashlight Goggles

CONVENTIONAL flashlights are all open to the objection that the user must give up one hand to holding the flash, or else must rig up a temporary base for the light when the job to be done is essentially a two-handed one. While is not particularly satisfactory, since the light remains fixed upon a single point instead of following the work as it should, a very clever scheme from this predicament is seen in the flashlight illustrated, attached to a pair of goggles. The lamp is between the lenses where it is out of the line of vision, and a shield is provided to protect the eyes from the light. Electric energy is supplied from a battery, not immediately attached to the lamp, but in the user's pocket and held by wire to the lamp. Obviously, the light must shine upon the precise point at which the wearer's gaze is directed.



The flashlight and the goggles which cause the flashlight to shine where the wearer is looking.



Naval hand-power vacuum pump

A Gas Mask for the Miner
GAZ MASKS have been used in several of the industries since the example of the World War taught some four millions of Americans their efficacy against poison gases. Firemen are now regularly equipped with them. Now comes one for the miner, called the "Half-Breath." Obviously, it is not the exact model used in the trenches. The miner has no need of one so elaborate and cannot be bothered with one so clumsy. But a manufacturer in Pittsburgh has put on the market a small though efficient mask that may be carried on the belt of the workman and which will not get in his way or be so bothersome that he will neglect to carry it. Ex-service men will multigly recognize the old mouthpiece of rubber to which is attached by a string the same old nose chopsticks that held the sides of the nostrils together four seconds after someone shouted, "Gas!" The rest is new. The little 15-ounce canister measures only four and a quarter by three and a quarter by one and one-half inches and is filled with a chemical known as Hopelite. This chemical converts the deadly poison carbon monoxide known to miners as "afterdamp" into carbon dioxide, which is the same non-poisonous gas that puts the fire in a red-winter.



The smaller canister that stops a wandering bell

Since the necessity of using the Self-Breath in a mine may come but once in a lifetime, it was necessary to provide a method of protecting the canister against dirt and abrasion while worn during very lengthy periods of time. Accordingly, the mask is covered with a seal of metal which may be ripped off very easily as it is attached only with soft solder. The chemicals protect against any concentration of carbon monoxide that is likely to be encountered during a period of 30 to 70 minutes.

Vacuum by Hand

FOR small work, the hand vacuum pump illustrated, which has just been put on the market, affords a very economical substitute for a power pump. In addition to the standard and recognized uses for such an outfit by chemists, doctors, dentists, etc., the manufacturer suggests other fields in which it would give good service. Thus, it has been found possible to line from pipe with lead by inserting the end of the pipe in moist lead and applying a moderate vacuum to the other end. The suction fills the pipe with the hot lead, and the latter cools where it is in contact with the iron. When the vacuum is released the molten core flows back into the crucible, leaving the pipe nicely lined with lead. The procedure would, of course, not be available for a long pipe length, but would do very nicely for a short one.

Another application lies in the extracting of liquids from inaccessible places—of water from a steam trap, etc. The pump is specially designed with reference to this sort of thing. The vacuum is created from a glass bottle, and carried from this out along the line applying in the way of a siphon. The suction brings home will enter the bottle rather than the pump, and will stay there until the bottle is tilted. In this apparatus may actually be used to extract acids. The pump is supplied both with and without the gauge.

Gas mask that protects the miner against carbon monoxide

A Bell Motorometer

THE standard motorometer with its red line and its dead line above which the red must not go, is a great saver of repair bills for the careless driver. But it does have to be watched, and it therefore leaves something to be done in the way of giving automatic warning of an overhauled engine. The bell attachment for the radiator cap which we have taken the additional step. Wound by hand as shown on the illustration, the bell acts as a thermostat, the spring is released when a certain temperature is released, and only a totally deaf chauffeur has any excuse for not knowing that trouble awaits him if he doesn't stop and investigate.

Carrier Current Makes Long-Distance Lighting Possible

EXPERIMENTS have been at the plant of the General Electric Company at West Lynn, Mass., proved, according to officials of the company, the practicability of sending high frequency carrier current, such as is used in radio com-

munication, over electric light feed circuits to light relay lights as far as four miles away from the generating source of the current.

Ordinary 110-volt household lighting current was converted into carrier current by means of a high frequency generator. The output was superimposed upon the 4400-volt house lighting feeder current running from the plant to Nahant, Mass., four miles away.

Two relays of electric lights at the Nahant end of the line were set to different carrier frequencies. When the carrier current frequency coincided with the adjustment of one relay of lights they would light up. But when the carrier frequency was adjusted to the other relay its lights would glow. The carrier current was transmitted over the lines without interfering with regular lights.

Tests have shown, according to the company, that any number of relays of lights attuned to different carrier current frequencies can be operated individually



Coil-spring shock absorber of unusual pattern

Another Shock Absorber

SHOCK absorbers are offered in numerous styles, but few are designed so as to become so integral a part of the suspension system of the car as the one here illustrated. Taking the place as it does of the spring hangers and of all other connection between the spring and the car, it has the direct effect of adding to the length of the spring. Nor is this addition measured by the mere overall dimensions of the device, by virtue of the positive action of the coil spring, the car spring works like one several feet longer than is actually the case. In addition to the coil spring with its unobscuring effect the device includes also a very effective rebound check.

Getting at the Milk Bottle

WHEN IT was, the old fashioned **F**ITTING cap for the milk bottle, with its spring clip, was always easy to get off, and it never gave the housewife a milk bath as an incident to its removal. Ever since recognition of the unsatisfactory character forced it to yield the floor to a card or paper cap that is used once and then discarded, the problem of easy and safe removal of the latter has been plaguing our inventors. The solution which we show at the bottom of the adjoining column appears to have merit. An aluminum cap the size of the bottle-top has two sharp prongs on its underside. It is placed over the bottle-top, the prongs necessarily pierce the paper cap. Then it is lifted off, and necessarily it brings the paper cap with it, while acting as a shield against the spew of milk which sometimes comes away with the paper.

The Crossing Signal That Cannot Fail

REQUIREMENTS for an electric signal protecting a railway grade crossing are severe. It must be capable of alternately opening and closing two electrical circuits having millions of times without a change in the contact adjustments and without causing rapid dete-



The working parts of the grade-crossing signal that can fail only on the side of safety

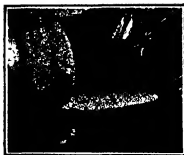
rioration of the contacts. The most recent attempt to meet this demand uses a totally different principle from a predecessors, instead of an exposed contact, these numbers are enclosed in a glass tube partly filled with mercury and held apart.

This apparatus consists primarily of an armature, oscillating freely between the poles of an electromagnet. To this is fastened a pendulum, which is oscillated in one direction by the electric current, whereupon the current is automatically turned off and the pendulum returns to its original position gravitationally. This cycle is repeated automatically from 80 to 100 times per minute. On this pendulum is mounted the contact tube mentioned above.

Without going into too great detail, it may be said that the contact is made of mercury, when the pendulum is in a slight extreme position, and broken while it is swinging from the one to the other. The device controls two (or more) red lamps, in such a way that first one then the other lamp is lighted. These lamps are in such positions along a circuit as are at the crossing that their successive flashing gives the effect of a single red lamp, swinging back and forth. And the device meets the requirement that if it fails, it must fall on the side of safety. For if the pendulum ceases to oscillate, it must return to the vertical



The splashless milk-bottle opener



The coiled spring in this driving cushion gives resiliency and ventilation.

position under the pull of gravity. Then one of the coils is resiliency permanently closed, and one or more of the red lamps burn continuously.

It will be understood that this signal works only when a train is approaching, the track relay supplying the impulse that sends current to the magnet and to the lamps.

A Crude-Oil Motor without a Carburetor

ONE of our German correspondents sends a description of the motor-cycle outfit illustrated herewith, jumping right into the heart of his subject with the confident pronouncement that "Herr Joseph Lowmy has after 10 years' work solved the problem of a crude-oil engine for the motor cycle," and lending a human touch by informing us that, when the inventor first led his production forth in public, "the crowd was extraordinarily large, in spite of the very cold weather." When the crowd got into to actual description of the apparatus, we learn that it carries no separate carburetor, but that the mixing of the gas takes place in the cylinder jacket, where we are accustomed to look for the cooling water. Only the upper part of the cylinder is ribbed (apparently for air-cooling), the lower half being surrounded and cooled by the flowing fuel. By this means the heavy crude oil, ordinarily difficult to this or to ignite, is so strongly heated that when sprayed through a nozzle it enters the cylinder without any edging. The motor works on a two-stroke cycle, and develops about one and one-half horsepower. It is started on hand, and run so for the first two minutes until it gets warmed up. In this connection great importance is attached to a two-way adjustable nozzle of extreme simplicity, which enables the switch of fuel to be made with no trouble at all. The account closes

with a personal touch, Herr Lowmy is a "well-made man," this English phrase apparently having been adopted by the Germans. Also, he is apparently not looking for capital to develop the machine, since our correspondent's final sentence pictures the inventor as "unable to save himself" from the impatient capitalist who are anxious to share in his prospective profits.

Motor Cushion a Coiled Spring

THE motor cushion for the convenience of motor car drivers is made as an 85-foot coiled spring wound spirally. It gives a good cushioning effect and at the same time maintains an air space to permit heat from the body to escape. The coil is closely covered with a woven textile allowing the circulation of air beneath and behind the back of the driver. It is said to be an unusually cool cushion.

Transformer Oils

THESE oils tend to form sludges, either slowly or quickly, according to the nature of the oil. H. Hill describes (*Electrical World*, New York) several tests that may be applied to the oil to determine its tar-forming properties, and gives references to original papers, where the description is more



Recently exhibited German motor-cycle engine, running on crude oil and dispensing with a carburetor.

complete. It is certain that the sludge-formation is a form of oxidation. One company has therefore introduced a type of transformer which the oil is covered with a layer of inert gas, usually nitrogen. A critical process, dependent on temperature and pressure, takes place, by which the nitrogen is driven out or sucked into the transformer. Any incoming air passes through an automatic valve, and is then deprived of oxygen and moisture, it therefore becomes dry nitrogen. Thus the oil, being in contact with nitrogen, does not oxidize, the layer of nitrogen also minimizes any explosive phenomenon.

The Greaseless Frying Pan

FRYING is an operation that requires grease, but the victim of the frying pan knows all too well that he gets too much of this grease in the finished food. It can be pork, pork chops, sausage, lamb chops, eggs, etc., be fried in grease and brought to a palatable food from grease! The inventor of the wafted frypan has illustrated his method as sought to answer this question, and he says he has used the pan in his own household for a year with very good results. The fat expelled by the frying delivery flows into the channels and stays there, where the food gets all the benefit of its presence without becoming steeped in it. Mr. M. O. Hughes of Alston, Mass., is the inventor.

The grease goes into the channels of this wafted frying pan, rather than into the food.

The Foot-Lock Vise

EVERY vice user has experienced difficulty in holding the work. If it is possible to screw the jaws down hard on the piece in the first place, after working with it for a while it will be found to be loose again. A very efficient vice lock is illustrated, which works with the use of the operator's foot. It is not an attachment for any vise, but must be actually built in. A kick upon the pedal locks the work against a pressure of several hundred pounds, and a kick releases it with certainty and dispatch. The spring lever attached to the pedal is the secret, the compounded purchase which this gives enables the jaws to be jammed tight against the work, no matter what the shape of the latter. The screw is used, as in the standard vice, to bring the jaws into approximate engagement with the work after which the foot-lock is called in to clinch the matter.

Fire Tests of Roofing Materials

THE Bureau of Standards has prepared a program of tests, equipment is being prepared, and test specimens constructed for conducting a series of fire tests of roofing materials with particular reference to the relative merits of wood shingles and prepared roofing. A conference has been held with rep-



The vice that uses foot-power and compound leverage to jam its jaws tightly upon the work.

Colorless Waterproofing Materials for Stone

INVESTIGATIONS are now under way at the Bureau of Standards covering the action of frost on building stones and on the value of colorless waterproofing materials with which to protect the surface of stone structures. During the last month the series of exposure tests on colorless waterproofing materials, having for its object the determination of the relative durability of these treatments under weather conditions, has been supplemented by a series of tests to determine the efficiency of the different waterproofing materials in preventing decay of the stone.

Crytallization tests are being made on waterproofed specimens to secure a comparison between treated and untreated specimens. Waterproofed specimens have also been exposed to the weather and will be tested after a considerable period of exposure.

Painting with a Wheelbarrow

CALIFORNIA'S highway commission is now painting a white line down the center of the highway north of San Francisco as a safety precaution to motorists. A very simple and efficient device is used for this purpose. It consists of a paint receptacle carried on a three-wheeled hand-truck, with a hose leading from the receptacle to a paint brush attached to the front of the device. The operator of the wheelbarrow brush spreads the paint to the proper width. A red line is chalked on the pavement ahead of the paint-spreader to guide the operator of the device.



Three-wheeled hand-truck used in painting the traffic line down the center of California roads.

representatives of the wood shingle manufacturers, the prepared roofing manufacturers and the fire underwriters, at which an agreement was reached on the methods of testing and on an outline of the program of tests.

Diffusion of Nitrogen Through Various Liquids

ONE of the difficulties which the Bureau of Standards has encountered in the reaction of hydrogen is the securing of hydrogen of sufficient purity. If other gases are present, they become frozen at a temperature higher than that at which hydrogen liquefies. This clogs up the apparatus and stops the process. The storing of hydrogen in any kind of a gas holder is, therefore, a matter of some difficulty because gases are very apt to diffuse through the liquid used in the holder and become mixed with the hydrogen.

Experiments were made during the past month on the relative rates of diffusion of nitrogen through glycerine, machine oil and water. It was found that the rate of diffusion through glycerine is very much lower than through water or machine oil. This was to be expected because of the extremely low solubilities of nitrogen and other gases in glycerine. The Bureau now proposes to employ glycerine as a seal for the gas holder used for the temporary storage of pure hydrogen.

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGE, U. S. A. R.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles.

Long-Distance Truck with Bunks

LONG-DISTANCE trucking is always a more or less complicated by the necessity for eating and sleeping on the part of the crew. In the endeavor to meet this, one manufacturer has put out the truck illustrated, with two bunks in the front seat. It is not the idea that one driver shall occupy the lower bunk while the other drives from the upper one—this is obviously prevented by the height of the latter. But this arrangement makes it possible for the two-man crew to live entirely in the truck until they reach their destination, and thus to eliminate much of the delay incidental to the nightly stop. Attention is also called to the comfortable inclined cab which permits all-weather driving

Rolling Palace Has the Comforts of Home

If you have a hobby for light person alised transportation and can write a check running well into five figures you can now gratify every desire for traveling luxury, distinction and novelty. Thanks to the utility value of the modern motor bus, an outlet has been given to the passion for a house on wheels or "sleeping coach" combining every modern convenience with the complete comforts of home, hotel and Pullman. Such is the motor palace recently acquired by W. K. Kellogg, breakfast food magnate and world traveler. Fond of travel, Mr. Kellogg has toured India, Japan and China and through virtually all European countries. He has made several trips to South America, has been in Alaska twice, in Hawaii and Egypt and now with his club car creation plans on renewing his acquaintance with America's wonders in a more leisurely and intimate way.

With the automobile home there is no further need to "check your baggage and come back later" for a room and bath. Now you just drive and drive and stop where you please. In the wildest wilderness if you like, without the slightest inconvenience—comfortable



By living in this truck, the driver and his helper cover long distances with a minimum of delay.

sleeping berths, shower baths, ample cooking facilities, graced too made as you ride, market news and entertainment by radio. The club car has all these conveniences and more. Inevitable looking panels of mahogany here and there conceal scores of unlocked for appointments.

The motor palace is finished in mahogany and the finest of leathers throughout. Entrance and exit may be made through five doors, three on the right side and two on the left. The driver's compartment is separated by a sliding glass partition. The forward part of the car is equipped with four revolving chairs with adjustable backs, head rests and arms which can be quickly converted into full-sized berths for two. The chairs are upholstered in tapestry plush with nickel fittings. Heavy adjustable curtains separate the

sleeping quarters from the rear compartment as well as the berths. The forward section may readily be transformed into a cozy dining room by the introduction of a folding table which, when not in use, is concealed in a panel at the side of the car. Ample light is provided by duco lamps and separate reading lamps at each chair. A dictograph permits conversation with the driver without opening windows. The coach is designed for use in winter as well as summer and passengers need not be concerned by weather conditions. Rotating fans keep the car cool in warm weather while heaters wet dash with the floor and connected to the exhaust pipe of the engine keep the car warm on the coldest day.

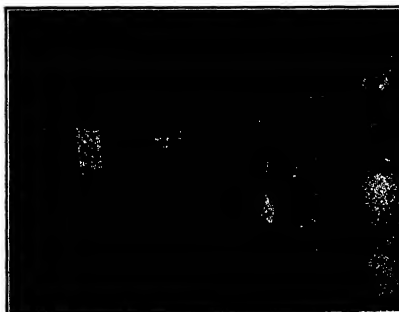
Further inspection of the rolling home discloses a windshield and floor cloths, oil and electric stoves, sink, faucets for hot

and cold water, an ice making plant, a low refrigerator, a china closet, a nickel lined basin, enclosed chemical toilet, French mirrors and drop-proof screens of the nickel mesh. Several electrical connections are conveniently located for carrying trunks, etc. All kitchen utilities and other appointments are concealed when not in use by mahogany cabinets and closets so that the general effect is of pleasing cabinet work and upholstery.

The water supply system for the entire coach is provided by a 40-gallon tank, pressure being maintained at all times by means of a pump driven by a power take-off on the transmission. An electric power plant in the rear section furnishes current for the lamps, stoves and fans. Installed outside of the car is an iron folding frame which can be used to carry light baggage and whose extended forms a large bed frame, which with mattress and rain cover offers additional sleeping accommodation. It is possible a few conveniences a completely appointed house should have, have not been envisioned. If so the number of ever-changing location has the up.

Motors Are Helping the Rural Schools

FOURTEEN THOUSAND rural schools are furnishing transportation for pupils to and from their homes. Through the motor bus the consolidated rural school is made possible and the number of consolidations is going forward at the rate of 1,000 per year. There are still 130,000 one-room schools which should be consolidated. Since a consolidated school combines several adjacent school districts into one school it means a larger and better equipped school-house, since in the one-room rural school one teacher teaches all grades from the kindergarten to the eighth grade, while in the consolidated school each teacher instructs but two or three grades. This means fewer and more highly qualified teachers and better teaching.



Two views of a luxurious motor home which contains every comfort found in the well-equipped American household.



The Heavens in November, 1923

Figures Recently Arrived at Regarding the Great Nebulae

By Professor Henry Norris Russell, Ph. D.

INTEREST is no chapter of present-day astronomy in which more rapid or remarkable progress is being made than in the study of the nebulae. A few years ago we knew little about them, except that they were hazy masses of light, far away among the stars, and that the luminous material was gaseous in nature, and not so in other respects as we think of them as grouped in three definite, though not quite mutually exclusive, classes.

First in order we may mention the vast dark nebulae, which we detect only because they hide the parts of the Milky Way that lie behind them. We owe our knowledge of these mainly to the lamented Barnard, who, single-handed and at great amid general incredulity, maintained and proved their existence. Some of them are so enormous that they appear as dark patches in the galaxy, easily visible to the naked eye, others are small and sharply outlined. It is fairly certain that they are actual clouds of matter, and that the dust in them produces most of the opacity by which we detect their presence. The nearest ones are at moderate distances—a few hundred light years—yet even so, they must be dense of light years long. These great clouds seem almost like reddish fragments of the primitive chaos. There is no reason why we must suppose that they have ever been other than they are.

Next come the luminous nebulae in the galactic region, including both the diffused and filamentary masses like the Great Nebula in Orion, and the rounded forms called "planetary nebulae." The beautiful work of Hubble has shown that these nebulae are always associated with stars, and doubtless derive their light from the stars. In some cases the luminous region is clearly only that part of a greater dark nebula which lies near the star and reflects its light. In others the luminous material consists of gas, which is set alight by the radiation of the star. Just how this happens we do not yet understand, but it is very significant that the stars associated with nebulae are always of the very hottest types—most of all, those which form the nuclei of the planetary nebulae.

The Spiral Nebulae

But the most remarkable problem of all is that we believe us to these nebulae which lie far outside the Milky Way, and form by far the majority. Hardly any of these are as gaseous as the spiral arms, and they are elusive in form. Thousands of them are round or oval, brightening up gradually toward the middle, smaller, though still great, number show spiral arms extending outward from a central mass—evidently in one plane, for we have many cases in which they are seen edge-wise. All stages of transition appear to exist, from a round structureless mass, through more and more oval forms, to cases in which the spiral arms seem just to have built out, those in which they are well developed, and others in which little of the central mass is left, while the arms have broken up into innumerable spots of light.

How this curious sequence gives us a clue to the solution of these strange objects, and we are merely reading into nature the fantasies of our own imaginations, so far-reaching a question cannot yet be answered fully, but there are many reasons to believe that the sequence has a meaning.

In the first place, these nebulae are in rotation. For the brighter and more portly, we know this with certainty from the spectroscopic work of several observers, following the rotation of the spiral arms. If this motion is in the direction which would carry particles at the rim of the nebula outward into the spiral arms, and its rate may rise to a hundred miles per second, or even more.

Further out, where the nebula becomes so faint that its spectrum cannot be observed, we may reasonably suppose, it is fortunately still possible to find the

motion of the individual nebulae condensations, by comparing photographs taken at intervals of ten or a dozen years. Van Maanen, at Mount Wilson, has been the protagonist in this difficult field. Seven different spiral arms have been successfully traced at some angle to the nebular points around the nucleus and, though to a lesser degree, outward, so that they appear to be streaming away from the center along the arms. The motions look slow (a few seconds of arc, at most, per century), but correspond to a complete rotation in from 50,000 to 200,000 years.

This is a surprisingly short period, for the nebulae are presumably very old, and yet the observed motions would carry their outer portions clear away, into the regions where we now see nothing, in a single million of years. Brilliant stuff is coming out of the nucleus and receding into space—blazing at first, then becoming dark. When one of these giant spirals is turned edge-wise toward us, this outer region can seem as a dark, opaque band, crowding the brighter portions.

great difference from the velocity of the central mass. If we can safely pass from this motion to the line of sight to motion in the plane of the nebula, indeed, we may by comparison with the photographs work out the distance. To do this we must know the angle at which the plane of the spiral arms is inclined to our line of sight. This is rather hard to find, but as the shorter diameter of the nebula appears to be about 100 light years or the longer, the inclination may be estimated at from 35 degrees to 40 degrees. The parallel then comes out 0.0002 second, the distance about 6,000 light years, and the rate of motion in the outer mass about 150 miles per second. The nebula is about half a degree in diameter, which, at this distance, corresponds to some 60 light-years.

This appears to be the most trustworthy estimate of the distance and size of a spiral nebula which has yet been made. Other methods, less direct but applicable to more nebulae, indicate distances of the same order of magnitude. We may well, for the present, think of the

larger spiral nebulae as lying at distances of several thousand light-years, and as being themselves a few thousand light-years in diameter. This is certainly big, but small indeed in comparison with the size of the Milky Way, which is measured in hundreds of thousands of light-years. It would be tempting to go on to estimate the mass of Messier 33, and if the motion of the outer parts was orbital it would be easy. The period of rotation, at 10 minutes of arc from the nucleus, comes out from van Maanen's figures at 170,000 years.

The actual size of the disk from the nucleus should be about 1,500,000 times that between the earth and the sun. To keep of this motion, the outer parts of the disk, at this distance, the mass of the nucleus would have to be 60,000,000 times that of the sun!

But fortunately, the motions of the various nebular particles do not follow the ordinary law of orbital motion under gravitation. The orbital velocity, instead of growing smaller at greater distances from the center, gradually increases, while the outward motion diminishes. This is extremely puzzling. The drop in the outward motion might be explained by the attraction of the nucleus, but the increase of the lateral motion, at right angles to the radius, demands the action of a force which is neither attraction nor repulsion, but acts sideways. No one has any idea what such a force can be, and it may take much work before the right clue is found. The most obvious suggestion is that the luminous points in the outer parts of the nebula are not flying freely in empty space, but are immersed in a great moving sheet of dark matter, which drags them along with it, but this, too, presents great difficulties.

By this means the spiral nebulae are still worlds to conquer. It is ground enough for satisfaction that we have no good idea of the size and distance of these moving islands, and that the further from its mass may be of some value. If there were not enough stuff in the nebula to make millions of suns, it is hard to see how the fast-moving condensations do not fly off in straight lines, instead of in their obviously curved paths.

The Heavens

By this means the spiral nebulae are migrating to our view. Orion is high in the southern sky, Pleiades and Sirius blazingly below. Gemma and Chama Minor are to the east, with the Pleiades further on. Perseus is high in the northeast, and Cassiopeia and Cepheus in the north, while the Dragon, who has been so long with us, is now far to the northwest, with Lira and Antares sailing below. The southwestern sky is dull, the great square of Pegasus being the only one of importance which is visible.

The Planets

Mercury is in conjunction with the sun on the 25th. (Continued on page 375)

At 11 o'clock, Nov. 7.
At 10 o'clock, Nov. 15.
At 8 o'clock, Nov. 21.

At 9 o'clock, November 28.

NIGHT SKY: NOVEMBER AND DECEMBER

Distances and Velocities

In the last nebula which he has studied—known as Messier 33, from its number in the catalog of objects prepared by that astronomer a century ago—van Maanen has measured four hundred of the almost countless spots of light in its outer portions. One of these showed a relatively rapid motion, and must be a faint star, far nearer us than the nebula, all the others fell in line with the majestic circulation, like a vast whirlpool, spreading outward. The labor of measuring, with all possible precision, so many objects—not to mention the faint stars used as points of reference—must have been enormous. In fact, the writer may be pardoned in quoting Dr. van Maanen's remark, after talking of the work, "Some time, after forty years or so, somebody ought to get new photographs, and measure a thousand points on this nebula. Before that time I hope to die!"

But the results richly justify the labor. Not only do they give the most complete knowledge of objects near those which we have yet attained, but they make possible, for the first time, a direct estimate of the distances of the objects. One condensation, in the outer part of the nebula, is bright enough to permit of spectroscopic determination of its radial velocity; and it shows a

Recently Patented Inventions

Brief Descriptions of Newly Invented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

ALBATROSS—J. JACOB, Paris, Fr. This invention relates to control devices for airplanes and has for its general object to provide means which may be installed in the structure of an airplane and which permit an exceedingly flexible control. It is also an object to provide means whereby the normal descent or ascent of the plane may be accelerated, and means whereby to facilitate the control of the airplane when in flight.

AERIAL PROPELLING MACHINE—B. V. CORNELL, 40 Chelsea Naval Cove, 55 Victoria St., Westminster, London, E. W. I., England. The main object of this invention is to provide a propulsive casing with deflecting vanes for producing a rotary propelling mechanism, and which can be actuated by means of suitable mechanism, in order to obtain an efficient utilization of the force developed by the rotation of the propelling mechanism in the required direction.

Pertaining to Apparel

GARMENT POCKET—C. W. WALKER, 2207 Broadway Ave., Oakland, Calif. The invention relates more particularly to a pocket which is best suited according to its particular use to workmen's garments, such for instance, as overalls, coveralls, aprons, coats and the like. Among the objects is to produce a pocket which will conveniently accommodate a quantity of nails or other articles, and remove the likelihood of the slipping out regardless of any tilted position.

GARMENT—J. ROBERT, 5 Decker St., New York, N. Y. One of the primary objects of the invention is to provide a placemat especially adapted for skirt slacks. A further object is to provide a placemat in which the material employed in the manufacture thereof may be reduced, thus making it possible to use scraps rather than good material and thereby reducing to a minimum the waste in good material.

GARMENT SUPPORTER—J. B. WALKER, 206 1st Nat'l Bank Bldg., Paris, Ky. The invention relates to a clamp element for use in connection with hose supports which reduces to a minimum the tearing or destruction of the garment by deflecting the support from a vertical axis of the garment. Further the invention also to produce a device which will properly associated, insure the retention of the garment against accidental displacement, while at the same time permitting of ready release and application.

Electrical Devices

TERMINAL FOR DRY BATTERY—H. M. CONNERY, 615 Street R. Battery Co., 101 Hudson St., New York, N. Y. The invention aims to present a type of battery which may be so constructed as to preclude the danger of any loss of the terminal clamps, the terminal further embodying the feature of adaptability to the carbon electrode so that no further work of the former from the latter, and a resulting bad contact is to be feared.

2.—WHAT IS A PATENT?

A PATENT is a purely statutory creation, and there is no common law right of property in an invention. In its inception the patent right was a monopoly granted by the Crown of James I. The English Parliament established the beginnings of patent rights as we know them in 1624, by taking from the Crown the right to exercise this power of granting patents, except in the case of inventions. The patent today is property; it is a franchise; it is a contract with the Government, by virtue of which the inventor, in consideration of his giving the public knowledge of his discovery, receives in return a monopoly thereof for a limited period, at the expiration of which the discovery becomes public property, and so far as that patent is concerned, may be freely made, used, sold or practiced by all. As patent rights are property, the owner thereof is entitled to the same protection therein, both legally and equitably, as in the case of any other property, and he may likewise by assignment, direct himself of his property as he may see fit. A patent, contrary to a general acceptance of the idea, does not grant the right to make or use the subject-matter thereof, it merely grants the right to exclude others from so doing, if the grant of the patent is not absolute. But the mere grant of a patent, even an entirely valid patent, does not preclude that the subject thereof infringes an equally valid but earlier and broader patent. Thus, the patentee may find himself the owner of a patent, and yet he may not be able to use the subject-matter of that patent without infringing the corresponding patent rights of another patentee. On the other hand, no one may, without the consent of the later patentee, make use of the patented subject-matter of that later patent.

TELEPHONE SUPPORT—J. J. MOSE, 3406 Lexington St., Chicago, Ill. An object of the invention is to provide a telephone support which may be readily secured to a wall or the like, and which has means for readily and instantly adjusting the telephone to the desired height. A further object is to provide a device which has means for supporting the receiver when the latter is not disposed on the telephone hook.

CHANGELABLE COLOR SPOTLIGHT—C. M. DILLON and C. D. SUTTER, Address C. M. DILLON, 30 Rogers Bldg., Columbus, Ohio. An object of the invention is to provide an apparatus for projecting rays from an electric bulb through a colored screen in order to provide illumination for exhibiting window displays. A further object is to provide a rotating color disk having transverse portions of different colors for creating the effect of continuous blending of color.

ELECTROLYZING APPARATUS FOR THE MANUFACTURE OF OXYGEN AND HYDROGEN—J. FAYARD, 120 Boulevard Malesherbes, Paris, France. The invention relates to apparatus to be used for the manufacture of oxygen and hydrogen, it comprises a tank and a pump for circulating electrolyte having tubular stems of the same material, a frame supporting the tank and supporting the electrodes and forward-nosed diaphragms of fine mesh and mounted at the frame and separating the electrodes.

Of Interest to Farmers

ATTACHMENT FOR TRACTOR—H. M. GREGORY, Corry, Pa. The invention particularly relates to an implement adapted to operate for preventing a wheeled tractor from turning backwards, upon the rear drive wheels, being held in a reverse or field, against rotation. An object is to utilize the movement of the tractor body or frame, when said tractor is turning backwards, for operating mechanism adapted to stop the power

to the driving shaft, the mechanism is simple and adapted to be applied to any type of wheeled tractor.

MANURE LOADER—F. E. NUTT, 1104 W. Springfield St., Urbana, Ill. The invention has for its object to provide a machine which is effective to collect and pick up the material from the ground, elevate it without loss or scattering, and transfer it to a lateral conveyor movable in either direction and controlled by an operator. The device is in general simple and durable, comparatively easy to operate, and inexpensive to manufacture.

TRACTOR HITCH—M. L. M. KROWEZ and J. M. BATES, Fort Branch, Ind. The general object of this invention is to provide a device which will cause a side draft hitch to function as if the hitch were center with the line of draft and which will be capable of automatically sliding itself to a complete turning movement of the tractor and yet be adapted to be made rigid as is desirable when operating over rough ground.

PENICILLIN ATTACHMENT—P. T. BARTLEY, 272 S. E. 2d, Newport, R. I. Among the objects of the invention is to provide an attachment at the top of the frame post for retaining a pipe or rod in position, and which in addition presents means for securing feeding wire and thereby permits the use of a comparatively short post and at the same time presents an ornamental appearance.

RAIN SHOCKER FOR HARVESTING—S. THOMAS, 253 S. 2d, Newport, R. I. The purpose of the invention is the provision of an attachment to be applied to various makes of harvester blenders whereby the bundles of grain delivered from the blower, being held in a reverse or field, against rotation. An object is to utilize the movement of the tractor body or frame, when said tractor is turning backwards, for operating mechanism adapted to stop the power

Of General Interest

LIFE BOAT APPARATUS—F. A. GOSWELL, 2010 Broadway, New York, N. Y. The invention has reference more particularly to an apparatus which is manually operated to actuate the propeller by compressed air, the boat hoisting apparatus said air being utilized in distilling salt water for drinking purposes. An object is to provide an apparatus which may be operated by the occupants of the boat for providing distilled water, and compressed air as power to operate the propeller.

COUPLING—J. ZARIN, 520 E. 51st St., New York, N. Y. The invention relates to a coupling particularly intended for connecting the ends of a coil or rope, or for attaching a snail to a fish line. The general object is to provide a coupling of very simple form with a view to promoting convenience in applying the coupling to effect a secure connection between the coupled elements. (See Fig. 1.)

WINNIE DOG KENNEL—C. CHAPLIN, 228 Madison Ave., New York, N. Y. An object of the invention is to provide a dog kennel adapted to be mounted on the outside of a window sill of an apartment house or other dwelling, and connected to the window frame in such manner as to be temporarily supported and protected from rain, the arrangement being such that access may be secured therein at any time from the exterior of the building. (See Fig. 1.)

COMBINED MILLER AND ELECTROTYPE—A. ATONA, Hialeah, Fla. One of the principal objects is to provide a device which facilitates the ruling of lines with the use of the miller, and to provide the paper, and the blotting of the lines or writing by rolling the blotter over the same device preventing smearing and further eliminating some of the time in picking up a separate roller. The device consists of a plurality of sections, the outermost being adapted to be removed and discarded when used for use. (See Fig. 3.)

COMBINED PAIR AND RYAN—A. C. HANCOCK, 415 Ann St., Hingham, Mass. In paper handling or any other form of labor where a pull is used it is necessary for the worker to frequently stop for digging the brush or the like. The object of the invention is to provide a combined pull and stand whereby the pull may be made to operate as a hold wherever the user may wish, and thus eliminate the time necessary for stopping.

FOOT HORN—F. P. FARR, Address D. P. Smith, Attorney Corry, Pa. The object of the invention is to provide a device for use with bookish stands or the like, which is adjustable and removable whereby when the foot rest is not in use it may be removed or adjusted so that it will not rest on the floor, but is in use it can catch and tear the clothes of a person using the rest, or improve the movement of the person in stepping upon or leaving the stand.

VANITY CARE—V. G. KIRKLAND, 118 Market St., Newark, N. J. The inventor

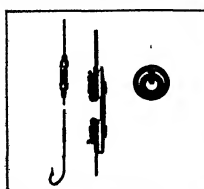


Fig. 1. The adjustable pocket which can be used for carrying tools.

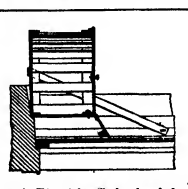


Fig. 2. The adjustable color spotlight.

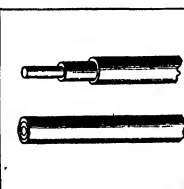


Fig. 3. The invention of A. Atona for combined miller and electrotype.

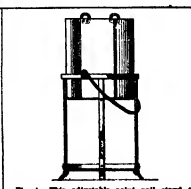


Fig. 4. The adjustable pocket which can be used for carrying tools.

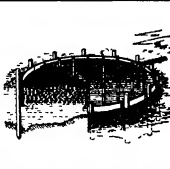


Fig. 5. To prevent examination, this lock, invented by A. S. Cooper, is manufactured in steel.



Fig. 6. Mouldings will approximate this design, portable methods, the idea of R. H. Gallagher.

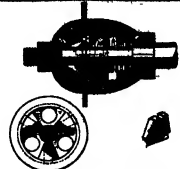


Fig. 7. To clamp and center, clamping pins, etc., this device was designed by C. L. Norris.

has been granted two patents of a similar nature relating to vanity cases adapted to contain a carrier filled with compact powder, and providing a form of retaining means on opposite sides of the central partition of the carrier so constructed that it will in no way interfere with the powder packing or pressing operation. The retainers may be removed from the case for the purpose of removing the compact when the same becomes exhausted. A further object is to provide a device which will be simple, neat and attractive in appearance.

SPIRAL ROPE AND CABLE GRIP.—G. J. ZIRK, 2315 Polanco St., San Francisco, Calif. The invention relates to means for securing a cable or rope around an object, as, for instance, a log of wood to be moved, or on the front axle of an automobile to be towed. A particular object is to provide means for temporarily securing a cable which can be fastened and unfastened without any effort and still positively secure the cable to the object so fastened that it cannot lose its grip, no matter how much towing power is applied.

GATE VALVE.—J. E. DEMPSEY, c/o Acme Cement & Plaster Co., Olive and 8th Sts., Acme, Okla. Among the objects of the invention is to provide a gate valve especially adapted for application to grain bins and the hatches of plaster mills, although the valve is capable of a variety of applications and may be applied to a cylindrical container and the attaching face of the casing may be conical and the discharge apertures either straight or inclined.

CLASP.—L. JANKEN, P. O. Box 1008, Station C, Los Angeles, Calif. Broadly speaking, this invention constitutes a clasp for jewelry including a pair of members, one of which is adapted to receive the other and within which former member means are arranged for engaging engagement with the other member to lock and retain the members together against separation, and a superiorly exposed means for releasing the locking means.

CLOSURE FOR CONTAINERS.—D. BROWN, 1038 Edith St., Berkeley, Calif. The primary object of the invention is to provide a closure which will positively seal and preserve airtightness and tameness, and which may be produced at a modest cost. A further object of the invention resides in the simple manner in which it is applied, which enables the closure to be used by housewives as well as packing operations on a large scale.

SCUPPED DRAIN.—T. C. KOWKE, Madrid, Neb. An object of this invention is to provide a scupped drain which is adapted to be used on a window or door screen and

which may be easily attached to the ordinary window screen without the use of nails or screws. A further object is to prevent the window screen and window sill from decaying by permitting the water to drain, at the same time preventing insects or the like from entering.

PIRE EXTINGUISHING.—P. BRADEN, 229 Madison Ave., New York, N. Y. The principal object of the invention is to provide a simple and inexpensive package which is indestructible by fire whereby the same could be used as a bomb to be thrown directly into the flames to extinguish the same. A further aim is to provide a fire glass closure readily broken by the finger to permit the emptying of the contents onto the flame.

MATCH CASE.—S. SPENCER, Box 461, Times Place, New York, N. Y. Among the objects of this invention is to provide a case or container for dispensing the contents thereof and delivering the matches singly, whereby the case may be employed as a holder for the lighted match to preclude the possibility of burning the fingers, means being provided for ejecting the used match, the device may be used in connection with common form, or safety matches.

WINDOW.—S. U. RUM, c/o W. H. Jackson Co., 335 Carroll St., Brooklyn, N. Y. This invention has for its object to provide a window arranged to permit of easily and conveniently moving the sashes up and down so as to regulate the window air and water tight at the time the sashes are in closed and open position, and without the use of packing strips or the like.

LOCKING DEVICE FOR FRUIT CANS OR TINS.—H. H. GUNTER, 214 E. St., Laporte, Ind. An object is to provide a locking device which is adapted to closely engage with the walls and top of the can whereby it will not interfere with the packing of the can. A further object is to provide a device which may be readily attached to cans of ordinary construction without altering their construction. The device consists of few parts, and is not likely to get out of order.

PACING FOR CEMENT WALLS.—F. A. NORTON, 4th and Wood Sts., Portland, Oregon. This invention has for its object to provide a pacing for walls whereby the exterior of the cement wall of a house or the like may be given a neat and artistic finish. A further object is to provide a device that the facing may be adapted to be locked in position at the time of building or pouring in cement.

DIVISION PLATE FOR EGG CAGES.—J. C. YOUNGSTER, 439 Star Bldg., Wash-

ington, D. C. The invention aims to provide a dense packing division plate capable of easily transporting eggs, bottles, fruit and the like, which will answer all requirements in the nature of conditions precedent to its use in storage, mass transport and through the mails. A further object is the provision of a plate which will be pliable to permit of expansion or contraction, and for properly fitted up-close compartments of non-standard dimensions.

MOUNTING FOR STYLUS REVERER.—O. W. RIZLEY, P. O. Box 220, Framingham, Mass. The general object is the provision of a simple mounting for stylus levers in sound boxes, provided with a self-compensating means for taking care of the wear in the levers. These objects are accomplished by the provision of a lever having a transverse extending at right angles thereto, forming bearings in the casing, one of which is a groove extending at an angle to the axis of the transverse, and mounting on the casing a spring which tends to draw the transverse along the groove to compensate for wear.

TRAY.—A. E. COOPER, 610 So. Broadway, Los Angeles, Calif. The invention relates to tanks for the storage of oil or other liquids which are lighter than water. An object is to provide a bottomless tank, this character partly embodied in a body of water so that it will be in connection with a portion for storage of fuel oil, with small leak by vaporation. The device may be easily erected and transported to different localities, the walls being of light construction, either of metal strips that may be rolled horizontally, of wooden staves with metal bands. (See Fig. 6.)

PORTABLE BRIDGE.—R. D. GAZEMAN, Bay St. Louis, Miss. Briefly stated, an important object of the invention is to provide a portable bridge, adapted for ranging over a water or other body, and which may be applied to the upper or lower side of the runway of a vehicle, and readily set up for use by a single person. A further object is to provide collapsible sides which, when swung to an upright position, will brace the portion of the bridge. (See Fig. 6.)

Hardware and Tools

CENTERING AND CLAMPING MEANS FOR RAWS AND OTHER ARTICLES.—G. L. NORRIS, 224 W. 3rd St., Wilmington, Del. The invention relates to means for centering the raws, and particularly to means for centering the raws on the arbor and clamping the same in position. The general object is to provide a centering and clamping means whereby to promote simplicity of assembling, secure fastening, and

to provide for the facility with which the raw or like may be clamped or released. (See Fig. 7.)

PIPE REPAIR CLAMP.—J. W. BRAD, 878 8th Ave., New York, N. Y. Among the objects of this invention is to provide a pipe repairing clamp for use in connection with boiler and radiators, and in which the device is to be applied to one of a nest of closely spaced pipes, by this device it will be possible to associate the body portion of the clamp with one of the nest of pipes (irrespective of the proximity of the next adjacent pipe).

BRACKET.—R. V. CHAMBERLAIN, 307 Campbell Ave., Schenectady, N. Y. This invention relates to brackets especially adapted for supporting shade rollers and curtain rods. An important object is to provide a bracket which is neat in appearance, stamped from a single blank of metal and having members whereby the same may be secured to a window frame without employing nails or similar fastenings, which may mar the appearance of the frame.

AUTOMATIC LOCK COOK.—J. T. O'CONNOR, 1908 Morris Ave., Bronx, N. Y. The invention particularly relates to a safety device for locking a gas cook or other form of valve adapted to be moved from an open to a closed position, and vice versa. The object is to provide a lock which will automatically become locked when moved to a closed position, but will permit the valve to be adjusted and manipulated by the same hand which opens and closes the cook. (See Fig. 8.)

FIXING TOOL.—C. H. BROWN, Broadview, Texas. An important object of the invention is to provide a tool for gripping or fixing, especially adapted for use in connection with all of other tools, having means whereby the same may be engaged with the foot valve of an oil well for the purpose of adjusting the valve, and a handle is so constructed that its movement upon being engaged with the valve is limited, whereby the spring arms are enabled to withstand the strain incident to use. (See Fig. 9.)

ADJUSTABLE BRASS ROLLERS.—BRAD, 604, Colusa, Calif. This invention relates to means used for imparting rotary motion to tools, such as bits, screwdrivers and others, the particular object being to provide a device which is simple and of the ordinary way but possesses novel features of adaptability and can be used in those cases where or under any conditions where the ordinary brass would be practically useless. The device or means is so constructed that the brass without materially increasing the cost of manufacture. (See Fig. 10.)



Fig. 8. For holding in place, this device is adapted to be used on a window or door screen and



Fig. 9. To hold in place, this device is adapted to be used on a window or door screen and

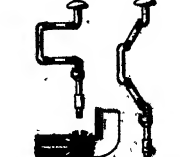


Fig. 10. An adjustable brass roll, this device is adapted to be used on a window or door screen and

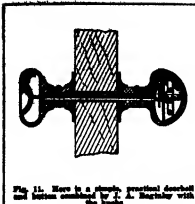


Fig. 11. Key in a newly patented device and bottom of door knob.

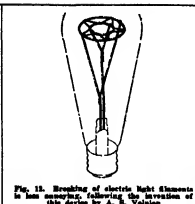


Fig. 13. Breaking of electric light filament in connection with the device.

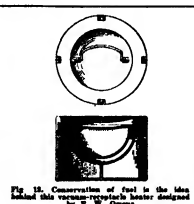


Fig. 15. Conversion of fuel in the idea behind the vacuum of the boiler.

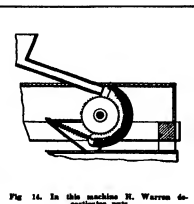


Fig. 14. In this machine R. Warren demonstrates.

FURNACE GRATE.—J. A. BERTON, 607 Jackson Ave., Elizabeth, N. J. The general object of the invention is to provide a construction whereby grates are heated from an increased area and the dead or dead grain surface is practically eliminated, thereby also an increased air circulation is provided at the sides and center of the grate and an increased easiness of movement in the shaking and dumping of the grate is provided for.

DOORBALL.—J. A. BARNETT, 2035 Pacific Ave., Houston, Wash. The object of the invention is to provide means whereby a ball may be carried on the knob of a door in such a manner that the ball may be easily operated from the exterior door knob. It is also an important object that the ball will in no way lessen the artistic appearance of the door knob. (See Fig. 11.)

Heating and Lighting

LAMP FILAMENT AND SUPPORT.—A. E. FULTON, 120 W. Washington St., Greenville, S. C. An object of the invention is to provide a filament and supporting elements with which the filament has contact at various points so that should the filament break or become disconnected, it is interrupted at one point the remainder of the filament will be broken in a definite way with the supporting elements and illumination maintained. A further object is to provide a support to prevent short-circuiting as well as provide strength. (See Fig. 13.)

GLASS CONSTRUCTION.—C. A. BARNETT, 808 North "B" St., Tacoma, Wash. Among the objects of this invention is to provide a glass construction for boiler furnaces and the like, as formed and arranged that the heating may be exposed or contrast longitudinally or transversely or become distorted on account of the heat or weight without interfering the supporting walls of the device or rendering the same unsatisfactory.

COOKING UTENSIL.—J. D. JAMES, Berkeley, Va. The object of this invention is to provide a cooker specially adapted for use in cooking or for cooking a number of foods simultaneously. The object of this is to provide means whereby the rise of the water level of the water cooking surface in steam pressure may be utilized to remove the steam pressure and thereby remove the water in the vessel, thus draining overlying onto the stove.

OLE BURNING ATTACHMENT.—A. KAMBERLY and A. LAYON, 12310 Woodward Ave., Highland Park, Mich. The invention relates to oil-burning steam engine

to atomize the oil or heavy hydrocarbon being burned and more particularly relates to an attachment designed to be employed in connection with the steam boiler of a hot air system, a hot air furnace or the like. The general object is to provide an atomizer arranged to promote convenience in installation, operation and repair.

VAPORIZER FOR LIQUID-FUEL BURNERS.—J. R. MALVERN, 9 Rue du Telegraph, Paris, France. The object of the invention is to provide a gasifying device for utilizing liquid, solidifying, charring, distilling and similar articles in which gasoline is used. The device is adapted to prevent the carbonization of the cotton wick by applying the same from the burner and thus insuring the proper functioning of the wick at all times.

BOILER AND WATER HEATER.—J. COVENS, 54 Centre St., New York, N. Y. The invention pertains more particularly to a device for utilizing waste heat in the chimney of a boiler. One of the primary objects is to construct the device that it may be attached to the chimney of a boiler in such manner as to utilize the waste heat for the purpose of heating water and providing a continuous flow of water at all times.

OLD-BURNING APPARATUS.—W. E. FENNER, 717 W. Main St., New Iberia, La. The invention relates to old burners for use in connection with steam boilers, a purpose is to provide an old burner by means of which the efficiency of the flame emanating from the burner is automatically controlled in accordance with the variance in pressure of the steam in the boiler and in such manner that the relative proportions of oil and steam applied to the burner remain constant.

Machines and Mechanical Devices

TAPE FEED FOR MOISTENING MACHINE.—R. M. BROOKS, 800 2d St., New York, N. Y. The object of this invention is for handling adhesive tape. A special object is to provide means by which a portion of the tape may be separated from a roll by merely pressing on a foot pedal and in which the separated piece is moistened simultaneously so that it is ready for immediate use.

HOISTING MACHINE.—C. U. Olin, 310 Chalmers Ave., Berkeley, Cal. Among the objects is to provide a machine for hoisting the shaft and rods from the wells. The foremost object is to provide a hoisting machine and rods from the wells, both being embodied in an automobile truck, and so arranged that when the coupling is joined in one way the truck will be operated

as usual, and when the coupling is shifted into connection with the hoisting apparatus the machine may be used for that purpose.

COBB AND CHICK.—P. De MARRA and R. De MARRA, c/o Messrs. Anderson & Munn, 238 Broadway, New York, N. Y. The invention relates to the manufacture of pneumatic tires. An object is to provide a core and chuck mounted upon a revolvable table forming part of a jack, and so connected that they may be quickly removed, and that the connecting device shall form an effective connection not liable to disengagement while turning the core at the tire is formed thereon.

HOP-BLAD RECEPABLE.—B. R. JAMES, c/o R. W. Brown, 25 W. 84th St., New York, N. Y. This invention relates to a portable receptacle of the vacuum type for holding a quantity of hot slag, the device being so constructed that the receptacle may be filled at the eruptive and transferred to a dwelling or other place where the slag could be used in a so-called fireless cooker, or for other heating purposes. (See Fig. 15.)

METHOD AND APPARATUS FOR DECONTAMINATING NITS.—J. WARRICK, 106 City National Bank Building, Galveston, Tex. The object of this invention is to provide a device for removing the fibrous material from the back structure with a cutting action along the line extending longitudinally of the nut, and simultaneously jerking the several portions radially of the nut and twisting them circumferentially with respect thereto. The nuts are fed to the hunker slaps, the hunkers completely removed and discarded from the nuts. (See Fig. 14.)

TURBINE.—J. D. BARNETT, c/o Brown, 2419 Arthur Ave., Bronx, N. Y. Primarily the invention contemplates a turbine having independently actuated rotor units mounted on a common shaft and arranged in a series to act as an apparatus for cleaning picture films. The object is to provide an actuator of the drive shaft to be obtained and whereby when one of said units is actuated, the other inactive units will constitute a belt and/or syphon for the oil. The turbine is constructed with a primary intake and a plurality of auxiliary intakes, and with manually controlled means for increasing or decreasing the pressure against the rotor. (See Fig. 15.)

PROPELLING ATTACHMENT FOR BOAT.—J. N. COVENS, 110 W. 115th St., New York, N. Y. This invention has for its object a propeller whereby a power can, with a comparatively slight effort, very readily operate the boat without any power which is connected with a support

readily applied to and removal from the boat structure. The support or frame contains all the necessary elements for propelling and steering the boat without requiring any alteration of the boat structure. (See Fig. 16.)

VALVE VALVE.—A. F. THOMPSON, 540 11th St., Brooklyn, N. Y. The invention relates to valves for outboard discharge pipes of ships. The aim is to produce a hinged valve which is so constructed that it remains closed at any angle from the horizontal to the vertical, irrespective of the rolling or plunging of a ship, yet requires a minimum amount of water to effect its opening. (See Fig. 17.)

ELEVATOR SYSTEM.—W. GREENE, 30 10th St., Woodville, La. N. Y. The principal object of the invention is to provide an elevator system involving the use of a plurality of cages and guides with supporting and controlling means thereby, whereby a cage is not limited to ascend or descend in a single shaft, but may be shifted at different levels from one shaft to another, whereby a greater plurality of cages may be employed than the number of shafts, and a greater number of passengers transported in a given period of time. (See Fig. 18.)

PORTABLE LIFTING MOTION FOR LOOMS.—J. A. COVENS, 815 Myrtle, Macon, Ga. The general object of the invention is to provide a positive lift-off frame by the action of which the warp will be at all times under perfect control. An important object is to provide a positive lift-off motion that will be independent of the beam as it is not to be subject to the variation due to the varying diameter of the warp beam.

FILM CLEANING APPARATUS.—M. COVENS, c/o J. Fulton, 1015 Longwood Ave., New York, N. Y. The object of this invention is to provide an apparatus for cleaning picture films. The object is to provide an actuator of the drive shaft to be obtained and whereby when one of said units is actuated, the other inactive units will constitute a belt and/or syphon for the oil. The turbine is constructed with a primary intake and a plurality of auxiliary intakes, and with manually controlled means for increasing or decreasing the pressure against the rotor. (See Fig. 15.)

APPARATUS FOR MANUFACTURING FLOWERS OF RUBBER.—J. K. LAYON, c/o J. K. LAYON, 12310 Woodward Ave., Highland Park, Mich. This invention pertains to a constraining chamber into which the rubber and molds are placed, which is manually divided powdered sulfur, which is commonly known as "flowers of sulfur." Among the objects is to so construct the chamber whereby the "flowers of sulfur" may be collected at a point where it is formed and separated and

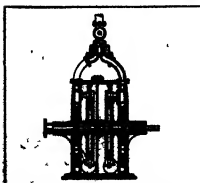


Fig. 16. This device is used to move the boat.

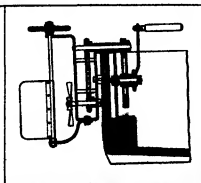


Fig. 17. This device is used to move the boat.

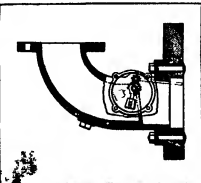


Fig. 18. This device is used to move the boat.

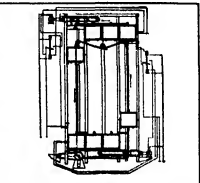


Fig. 19. This device is used to move the boat.

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an accurate estimate of the number of particles in a mile inch of cement. However from data gained from these tests with the air analyzer, it appears probable that about 4,000,000 cement particles could be placed in a single layer on a plane of glass one inch square. In a cubic inch, then, there would be approximately 14,000,000,000 of these particles, instead of only 40,000,000 as so that would occupy that space if all the particles were just small enough to pass through the openings of the 200-mesh sieve (100-th inch square) which is the size usually used in making the regular test of the fineness of cement.—*Cement, Mill and Quarry, 23-2, p. 52.*

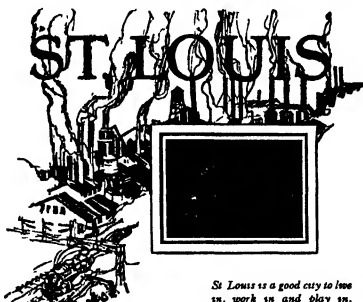
The Proposed Bridge Across the Golden Gate at San Francisco would span a gap of 6600 feet and for this purpose would have a 4000-foot center span and two shore spans of 1300 feet each. As the self-weight of the cantilever limits its spans between piers to about 1900 feet maximum a bridge is proposed which combines the cantilever and suspension principle. The cables of the suspended span, instead of extending the full length of the center and side spans, lie into the ends of the cantilever arms at points which are so selected as to secure the economical length for both types of construction. In this case, for the single span of 4000 feet there would be needed only a suspended cable span length of 2600 feet. This design is known as the "cantilever-suspension" bridge. The span will provide a clear span of 200 feet for the passage of ships. The two main piers will be 200 feet from base to top, and superimposed on them will be steel towers 140 feet high. These will be main verticals at the base will be 115 feet. The total length of the bridge proper is 8640 feet. The two main cables will be 20 inches in diameter. The cross-sectional width of the bridge is 60 feet, providing for two trailer tracks, two lines of motor cars in each direction and two 7 foot greater than that of the Manhattan Bridge and 700 feet greater than that of the proposed Bixby Creek Bridge. The estimates call for a total cost of about \$10,000,000.—*World Power, 11-10, p. 103-1.*

Experiments with Rubber Paving are being made in England. Large slabs of rubber two inches thick are to be used, each slab weighing about 600 pounds so that creeping and lifting will be reduced to a minimum. The surface of the slab is corrugated, giving a safe foothold for horses. The whole is placed on a concrete foundation and the joints are cemented with tar.—*Concrete Magazine, 46-4, p. 212.*

A New Type of Caboose for freight cars has been built by an Ohio railway company in order to provide a different method of train inspection from that furnished by the conventional cupola. The new design employs side-bars and does away with all overhead structures. The side-bars are provided with tall, narrow observation vanes down each side of the bay, and these permit the trainman to see along the train. The windows are set, allowing them to be opened and allowing the familiar sight of a lookout to reach the trainman. As the side-bar observation windows are lower down than the cupola windows, the lookout seats are made lower than they would be by the trainman. The bays are provided with seats so that the trainman may have a better view under observation much better than when the cupola caboose is used.—*Railway Age, 75-5, p. 207-6.*

General

Bootlegging in Rubber is one of the reasons why the recent effort of the British rubber growers of India to restrict the world supply has largely failed. The British grow about 70 per cent of the rubber used in the United States. The price of rubber in 1921 and 1922, before the Stevenson restriction plan was adopted, ranged from about 15½ to 18 cents a pound, while the fixed charges of the average rubber plantation, before a pound of raw material is produced, are about 15½ cents. When the success of the plan proved apparent in 1923, rubber buyers, the price rising to about 35 cents and nations also thus reduced this rise in cost. Some months later prices began to sag and in June of the present year had already fallen to about 26 cents. The two chief sources of this sag in the price of rubber are, first, the British East Indian plantations, which are not included in the plan, produce over a quarter of the world's output, second, there was great difficulty in enforcing the restriction among the British planters themselves. There was considerable illicit trading in the permits necessary to export specific amounts



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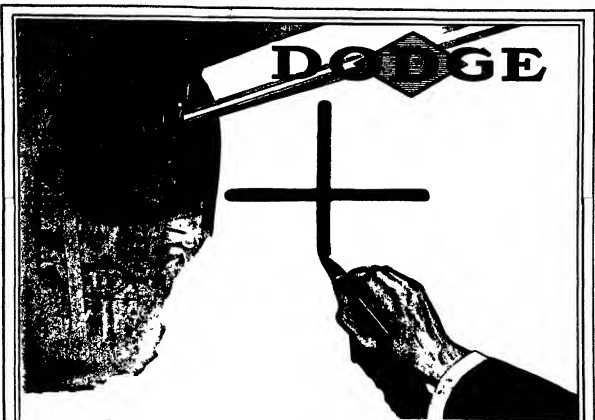
precisely a "Spach" for steam. It works on the principle that the amount of steam that can be stored in a fixed volume varies inversely with the square of its temperature, and hence its pressure. It tends to keep steam above the pressure when you give it off, just as it kills. The steam condensate in flanges has found its place in the "Spach" plant where heavy amounts of process steam are used in widely spaced industrial plants in pulp and paper mills. It provides short peak demands of perfectly uniform intensity.—*Eng. Rec., p. 30.*

The Recovery of Ammonia from the Exhaust Gases within the range of capacity and short compared with the highest cost of producing it in a separate ammonia plant is the goal of a group of workers at a Government laboratory at Washington. In experimental campaigns have been devised and put in use and is developing pressure up to 10,000 pounds per square inch. It is expected that the research work will furnish the data necessary for the installation and operation of small ammonia plants throughout the country. The direct synthesis-ammonia process for the fixation of atmospheric nitrogen is the newest of the three processes which have been brought to a commercial stage. In this process a purified mixture of nitrogen and hydrogen is subjected to a very high pressure and brought in contact with a suitable catalyst, and is maintained at about 200 degrees Fahrenheit. Under these circumstances, nitrogen and hydrogen combine chemically to form ammonia in quantities from 5 to 15 per cent of the gases present. The ammonia so formed is removed, and the uncombined gases are returned to the apparatus and again treated. Estimates indicate that a plant capable of converting 100,000 cubic feet of hydrogen into 2000 pounds per hour could be constructed for \$50,000. In such a plant, ammonia could be produced at from six to seven cents per pound, exclusive of royalties and cost of hydrogen.—*Compressed Air Magazine, 2d st. pp. 160-163.*

Freezing of Catalyzes in water kept slightly above the freezing temperature by a new method of avoiding loss in shipment from the Imperial Valley of California to the East. The method consists in placing an endless platform carrier, which takes them in crates down a series of rollers into the water tank. The water in the tank is maintained at a temperature between 35 degrees and 40 degrees Fahrenheit by ammonia coils. The catalyzes are carried slowly through the water, remaining in the tank about 80 minutes and coming out with a uniform temperature of 40 degrees Fahrenheit. They are loaded immediately into the cars and started to the city markets. Excessive tests were made to see whether water would penetrate the catalyzes, rendering them unfit for use. The tests showed that they were not, but some of these difficulties has been experienced in the early stages of the process.—*Ice and Refrigeration, 2d st. p. 65.*

Refrigerating for Internal Combustion Engines.—Cold, but not too cold, is the secret. Two fuels for internal combustion engines, a liquid and a solid. When you get the bulk of the distillate is liquid, and this liquid has a solid. When you get it in Europe as a fuel for Diesel engines. The solid is diesel kerosene. This may be constituted and recrystallized in life, by a very simple process, a hydrocarbon sulfide runs to serve as a fuel for internal combustion engines. Naphtalene has been used successfully as a fuel for internal combustion engines in the production of motor cars. Its boiling point is high and close to the boiling point range of much of the gasoline sold in the United States. To drive such motor cars require some modification of the engine, fueling and carbureting mechanism. Most motors that the modification is made, and the engine is then completely changed to start and run for a short time on gasoline. If all the objectives met, the engine is then changed to the United States in 1930 had been changed in a certain number of cases, and the production of fuel that would have been about 100,000 gallons of distillate, or 100,000 gallons of diesel kerosene with 100,000 gallons of diesel kerosene.—*Eng. Rec., p. 30.*

Heavy Duty Diesel Engines may be manufactured as a unit of about 1000 to 1500 horsepower in the United States. The Diesel Engine Company, of Appleton, Wis., has announced that it has developed a 1000-horsepower Diesel engine that is capable of running on a wide range of fuels.



Plus or Minus?

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efficient boilers and a dependable fuel supply on the one hand, and to the latest in productive machinery on the other, give slight heed to the link between these two elements—machinery for the transmitting of power.

Dodge means power savings. Plants which have standardized on Dodge transmitting units from boiler room to finishing machines, rank on the plus side of the ledger.

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After an extensive investigation among manufacturers in a dozen states, the Dodge Manufacturing Corporation has determined to interest the executive in an element of his production machinery which in the majority of cases has been taken for granted.

In plant after plant, Dodge representatives have been condemned into immensities and ultra modern power houses and from there to the latest of production machinery, for both of which the executive had no end of praise.

But the limit between boiler room and production was in many cases lightly passed over. The executive expressed an opinion favorable to group drive and knew his reason. But when it came to the element of that drive he was generally vague.

"We are going to sell power transmitting

machinery on the business basis," was the decision of the Dodge Manufacturing Corporation. "We are going to prove the existence of a power thief all along the line between boiler room and machines. We must show the executive that there is a figure in regard to delivered power on the monthly report can be indicated and that Dodge Transmitting Units mean power savings."

For 43 years, the Dodge Manufacturing Corporation has been an enemy of friction, while in the power thief Dodge equipment, which includes everything for the mechanical transmitting of power has always given "plus service" in the delivery of generated power Dodge Transmitting Machinery, where it is adopted as standard by many businesses, is functioning day in, day out over long periods of years, and paying a

profit on its cost and installation by actual savings in power.

Dodge products include everything for the mechanical transmitting of power. Extensive factories at Mishawaka, Indiana, and Oneida, New York, are equipped to meet every demand for pulleys, hangers, pillow blocks, shafting, rope and belt drives. In addition, Dodge manufactures conveyors of a distinctive and most practical type.

Extensive foundries employing skilled employees have most special engineering positions in regard to built-to-order machinery. Under 14 factory branches, are a production department, a design department, a sales department, a service department, a construction department, a maintenance department, a repair department, a painting department, a machine shop and a machine shop.

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formulation of color affects than any hitherto possible. The unique feature of this machine is that it permits very nice adjustments of color relations to be made on a whirling disc while the disc is in motion. For instance a yellow disc is placed on the machine and the blue disc is placed partly over it. The two colors blend and the proportions of each color may be shifted by the operator without stopping the disc through the use of an intricate system of cones and levers.—*Color Trade Journal* 15 2 p 66

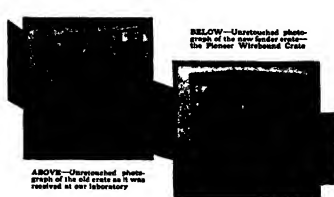
Vitreous Enameling with Electric heat has within recent years developed into a large industry. The electric furnace has demonstrated that it is without a peer when the results from the use in baking vitreous enamel are compared to that fired furnace. The control of the heat flow is so complete that uniform temperature may be applied in baking a complex shape even though the heat flow or heat quantity varies in different parts of the charge. In case of apron bath tubs for instance no difficulty is met in achieving the required amount of heat at the same temperature on either the apron or reverse side of the tub and such manipulation of heat is impossible with other than the electric furnace. In addition to the temperature control the electric furnace is possessed of a long life and low power consumption. Boiler furnaces which are expensive to manufacture are absent in the electric furnace and its low current against high percentages of rejections from this cause. The electric furnace has no toxins in its fumes such as are experienced with coal and oil firing. It has been able to handle 170 tons in 10 hours as against 120 tons with the oil fired furnace. Heats have been completed in 40 seconds that would require 5 minutes 40 seconds in the oil furnace.—*Journal American Ceramic Society* 6 T pp 794-8

Mechanical Engineering

A New Method of Joining Pipe Joints for aviation walls has been developed during the past few months. By use of the 12 centimeter flame screwdriver the joints are used may be done away with and the well casing will become a single tube of indeterminate length. Oil well casing has been used as it is welded many years but asbestos or oil well is usually larger and requires a different type of joint. In the case of a well being sunk in New Jersey six 20-foot lengths of 18 inch steel pipe three-eighths of an inch thick were used. First four lines were welded on the outside of one of each section of pipe with half the 12 inch extending beyond the end. Property to allow for construction sections of casing were prepared for welding by separating them about one diameter apart with small steel wedges which were melted into the joint as the welding progressed.—*Oil and Gas Journal* 21 p 10-11

Studies on the Heat and Cold Working of Brasses made recently in Germany in a laboratory indicate that all brasses be obtained from copper and ending at 64 64 and even somewhat richer in zinc composition can be pressed and drop forged at any temperature below the range of zinc evaporation. It was found that the application of the pressing load of the line force of the falling hammer must be individualized for each particular brass. No attempt to work all of them in the same condition or by means accustomed to some particular conditions can be successful. Probably the investigation concludes there is a great influence due to the flow factor that is the comparative amount of heat treated successfully to produce a suitable reduction under a given load or pressure.—*The Metal Industry* 25 8 pp 218-21

A New Type of Diesel Engine has been invented and put on the market by a well known manufacturer. This engine has low compression and has a lower exhaust temperature than present type of Diesels. The secret of construction lies in the method of introducing the oil to the cylinder and its combustion therein. Acting under the belief that air compression of from 200 to 300 pounds gave ample heat to ignite oil in globular drops, the inventor devised a method of uniting oil and air under proper conditions for a continuously recurring engine cycle. By using a check valve through which oil is admitted to the center of a burner composed of an inner and outer sleeve so contained and proportioned that they form a small combustion chamber between the sleeves, and a relatively larger combustion chamber within the inner sleeve this is accomplished. Both sleeves are open at the bottom, and the two combustion chambers are open at the bottom and communicate at



ABOVE—Unstrapped photograph of the old crate as it was received in the laboratory

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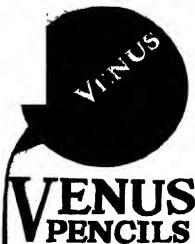
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as opening or closure as might be desired. Moreover, the area of this opening is not restricted. Consequently the valve ports need to throttle the steam to such an extent that full boiler pressure cannot be realized in the cylinder. Steam designers have, therefore, been impressed with the possibility of improving steam distribution in the cylinder by means of the lift type of valve. The latest and most practical piston valve mechanism designed to improve steam distribution in the locomotive cylinder is found in the Fillis slide valve which has recently been fitted for the first time to a locomotive of modern proportions. It was found that this type of valve enabled a locomotive to perform the same amount of work with less steam, because it is used more expansively than in the case of the ordinary type of piston or slide valve. This valve mechanism, consisting of an ordinary piston valve and two shoves, enables the locomotive to approximate the conditions found in the best Cottrell engine operation and it is reasonable to look for a really fundamental improvement in locomotive operation through its use.—*Railway Review*, 72, 24, pp. 263-65, and 73, 7, pp. 226-28.

Shipping

Thirteen Years Afloat without Dry-docking is the record of the British steel training ship "Dromedary" which was recently docked and graved at Tilbury. Her crew, positive immunity from rust is attributed to the fact that when she was first launched no paint had been applied to her hull and she lay in the water for some weeks while being fitted up. During this time the sea water had an opportunity to destroy the millscale on her plates, which is the secret of the record period during which she did not have to be graved. After being about a few weeks she was drydocked and her bottom was cleaned with wire brushes and fresh water and was painted. It is considered that the formation of the millscale during the process of manufacture of steel plates is the cause of serious corrosion. This millscale is formed, to a large extent, by the sand which is thrown on the plates during the process of rolling in order to enable the rolls to take a proper grip. Six months after going to sea, owing to vibration and to expansion and contraction, about half of this millscale has fallen off, taking the paint with it. The vessel is then placed in drydock, superficially scraped and repainted. In many places, however, rust comes have formed and the result is that paint is applied over rust, and the rust spreads under the paint. It is now being advocated that ships be launched without paint, so that the millscale can be done away with for good and all.—*Shipping and Shipbuilding*, 42, 4, pp. 123-5.

Miscellaneous

Be Careful of Asking for Telegrams Collected.—A mayor of a Pacific Coast city recently declined a radio broadcast station and he was so pleased with the suggestion that he asked everybody to send him telegrams collected so he could see how his votes carried. He began to find out by mid night when he had received replies—collected from every state in the union as well as from Honolulu. He received a wireless from a ship 1000 miles out at sea. The votes up to his bank account about \$2000.

The Post Office Department Locksmiths.—The postal laws and regulations forbid locksmiths from repairing mail receptacles or repairing locks themselves, and as a result 15,000 locks sent during the year to the mail equipment shops in Washington to be repaired. The average cost of repairing each lock amounted to about 42¢ and a half dollar. Figures just compiled show that the Post Office Department manufactured 350,123 locks during 1922 at a cost of \$79,000. In 1921 the cost of locks turned over for the use of the postal system was 130,250, the cost being \$47,000. According to these figures, 215,215 more locks were made furnished in 1922 than in 1921.

Pencil Pigments in Writing.—In a recent issue of *Discovery* Mr. G. Alenworth critically discusses the coloring of identification of pencil pigments in writing. He shows that the microscopic appearance of lead and its alloys is quite distinct from that of graphite, the lines showing a disconnected series of patches irregularly distributed, uniformly and brilliantly lit up, and each patch marked with regular vertical striations. Writing in different pencil pigments may sometimes be differentiated by chemical tests. For example, the graphite and lead used for the pigment frequently contains very varying amounts of iron or of arsenic, and



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It is the ideal set for use in apartments, automobiles, yachts or railroad trains where an antenna is not practical. Extremely sensitive, unusually receptive, yet simple to operate.

Write today for our folder
"California or Newark"

MOON RADIO CORPORATION
501 Seaboard Ave. Long Island City, N. Y.

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New Bixie Bldg. Montreal, Quebec

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-RADIO-

Radio Notes

Wired Wireless Communication.—A pamphlet giving an introduction to wired wireless or line radio communication has recently been prepared under the direction of the chief signal officer with the cooperation of the Bureau of Standards. This pamphlet gives an explanation of how messages are carried to distant points by radio-frequency currents directed over wires such as ordinary telephone lines or power lines. The fundamental principles of radio and its relations to line radio telegraphy and telephony are also discussed. This pamphlet is "Introduction to Line Radio Communication." Signal Corps Radio Communication Pamphlet No. 41, a copy of which may be obtained for 10 cents from the Superintendent of Documents, Government Printing Office, Washington, D. C.

Radio Dramas have been broadcasted by the WOL station of the General Electric Company at Schenectady for nearly a year. During that period the little group of WOL Players has had the largest audiences ever before recorded dramatic offerings. There are at least 2,000,000 radio sets in the country, and of that number 1,500,000 are almost nightly within range of WOL. From the very first the radio drama has been a success. Mr. Edward H. Smith, formerly an actor and director on the professional stage, has been handling this feature of the WOL programs. Mr. Smith and his players have planned in the art of the radio drama. They have had to develop a new technique. It has been found necessary to make occasional changes in play manuscripts, especially where a climax depended upon sight for its appreciation. The entrance to or departure from a room by one of the characters has to be indicated by sound, as a closing door. A bell jingle sometimes is substituted a newswoman in the liveliest stage. Various sound devices have been created to produce atmosphere. A telephone key and an imitation of an engine which have helped in a railway station scene. Storms have been simulated by device similar to those used on the stage.

The Association of Loud Speakers are dissatisfied among other things by Mr. Newman in the Journal of the American Institute of Electrical Engineers. "Speech and music are both needed considerably, depending upon the length and shape of the horns, also the volume of the sound," states this authority. "A horn longer than one-quarter wave length of the lowest pitch available gives the best reproduction. However, he practices the length of the horn seldom exceeds three feet, approximately one-fourth of the wave length of 60 cycles, the fundamental of the horn. If the horn is shorter than one foot (270 cycles fundamental) the bass and baritone voices are likely to be distorted, since their fundamental, which is below 270 cycles, would be reduced. It has been found that a loud speaker with a magnetic balance and a horn about the feet long is capable of very good reproduction of even very low frequencies. Careful study has been made of materials to be used in diaphragms and in the horns so far as it affects the quality of reproduction. Aluminum or mitered diaphragms apparently give the best results, while a wood horn or horn made of some 'dead' material like hard rubber is least likely to introduce a strange quality."

Our Japanese Radio Link.—The radio telegraph circuit between the United States and Japan is operated continuously, carrying a large portion of the trans-Pacific telegraph traffic. When the recent disastrous earth quake devastated Tokyo and Yokohama the radio service was not interrupted. The first news of the disaster came to the United States over this radio circuit, and for several days thereafter the most complete dispatches describing the extent of the losses and damage came via the Radio Corporation service. There are several Japanese stations working with America. First, there is the JNR radio system, owned and operated by the Japanese Government, comprising a transmitting station at Hamamatsu and a receiving station at Yokohama. The general location of these stations was determined by the cooperative freedom of the dispatch from Hamamatsu. The transmitting aerial at Hamamatsu is of the umbrella type, supported by a self-supporting central tower and an outer ring of 15 radial, spaced wooden masts at a radius of 1000 feet. The receiving tower is a reinforced concrete tube 300 feet high, 77 feet in outside diameter at the base and 14 feet outside diameter at the top. Wooden masts in the outer ring are 200 feet high and consist of three sections.

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Very light!

*flexible and easily
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Whether you're a little kid who wants to listen to the radio or a grown-up who wants to listen to the radio, the Hellogo Receiver is the answer. It's a very light and easily adjusted receiver that can be used in a car, on a boat, or in a room. It's a very light and easily adjusted receiver that can be used in a car, on a boat, or in a room. It's a very light and easily adjusted receiver that can be used in a car, on a boat, or in a room.

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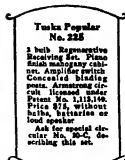
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The Burgess "A" Dry Battery is the most powerful and reliable battery ever made. It is used in all types of automobiles, trucks, and other vehicles. It is also used in many other applications where a reliable power source is required. The Burgess "A" Dry Battery is the most powerful and reliable battery ever made. It is used in all types of automobiles, trucks, and other vehicles. It is also used in many other applications where a reliable power source is required.



The thrill of great distance

For 15 years, Tuska-built radio receivers have been famous for long-range reception, and have made records that are unsurpassed.

F. R. Allen, of Prince Albert, Saskatchewan, Canada, says: "I am sending a list of 37 stations at a total distance of 75,700 miles away. You will realize that all stations are far removed from the coast of their home or some over 1000 miles. The Tuska is remarkable for simplicity of tuning. It has been a source of great satisfaction."

You needn't know a thing about radio

NIGHT after night, year after year, a Tuska Radio will bring fine entertainment into your home, at a trifling expense for operating.

You need not depend upon good-natured friends with radio experience to help put a Tuska in your home. Surprise them all by doing it yourself. It is easy to install your own "listening post" and pick up your choice of the wonderful concerts that fill the air.

At pleasure you can tune out any program and tune in another more

to your liking. The same Tuska that fills your rooms with clear, unmarred music and distinct speeches will also pick up broadcasting from stations 2000 or more miles away. It is selective, yet simple in tuning.

Some of the most experienced radio inventors and engineers in this country designed and built the Tuska. It is right, forever, and needs no tinkering. Have no fear that it will soon become obsolete. A Tuska set bought to-day will be serviceable for years to come.

THE C. D. TUSKA CO., Hartford, Conn.



TUSKA RADIO

The Drama of Disputed Documents

(Continued from page 303)

[illegible]

The reader will find on these pages some samples of typewriting as submitted to a Commission on the subject of the "Cervino case" some years ago. There had been a hot fight over the kind of machine to be used in the Federal Bureau of Investigation for their building. In the course of the fight, two communications, both anonymous, were sent into the district of Columbia. One was from a "Communist" and the other from a "Republican" party. Complaint was made that the "Communist" communication had sent out these communications for the purpose of deriding and defaming the other man. In order to establish the point, the original communication was typed on a machine which reached the conclusion that they had been written on one and the same machine. It was then typed on a machine which revealed that there was such a machine in the office of the accused Congressman and that the machine was the one which he had obtained. Cervino thus enlarged the original and the samples. Next he juxtaposed the two communications and the samples of other writing from the suspected machine. In this way he demonstrated, by means of a simple test, that the two communications and the other writing had been done by the same man. The writer had been done on the typewriter in question and that the campaign of slander was true. It was done by or with the probable true author of the "Cervino case."

Questions of handwriting often play vital parts in the destinies of great families, where corrupt lawyers, scheming adventurers or criminals of even darker dye find some method of gaining a profit out of falsification. No more sensational case of this kind ever came into the courts than that which involved the legitimacy of all the children of the financier, Jay Gould. This case was tried in New York State in 1890.

A woman named Margaret E. Cody wrote a letter to George J. Gould in that year, stating that she had the evidence to prove that his father had married a Mrs. Angel in 1893, that a child of this union survived, that Jay Gould and Mrs. Angel had never been divorced and that the Gould children were, accordingly, illegitimate and not entitled to their enormous inheritances. A baptismal certificate and marriage papers figured in the case, as did an entry on the record book of a small church uptown. (Marriage Records were not known to 1893.)

The affair was, of course, full of sensational possibilities and gained immediate and enormous notoriety. The idea that all the members of one of America's richest families might suddenly be reduced to the status of illegitimacy and deprived of their riches was an all too honeyed morsel for the tongues of smut.

Two criminal trials resulted. At the first there was a disagreement. But Mrs. Oody was again hailed before a jury and it was shown, by means of expert testimony, that the ink of the alarum record was new, that the page showed erasures, that the signature was not that of Jay Gould and that forgery had been committed on all sides. Mrs. Oody was acquitted and eventually admitted part of her responsibility for the plot.

Wills are and perhaps always will be the favorite target of the falsifier. Every year sees many surrogate trials in which the last testament of wealthy men are attacked and slipped into the hands of experts for opinions as to their authenticity. And that that the

makers of wills cannot raise their voices out of tombs and denounce the guilty seems to lead many falsifiers into this line of fraud and heartless deception. However, it is the extreme rarity for such forgeries to go undetected and such schemes to succeed.

No more striking case of a subtle attempt to profit by an altered will can be cited than that which had to do with the last testament

George P. Gordon, 55, with his last testament, the printing press which bears his name. Mr. Gordon died in 1878 at his home in Orange, N. Y., and left a wife and two children. The heirs accordingly made an agreement with themselves for the partition of the said main tract of land, and the same was approved by the court.

Under the terms of the agreement, which included these appraisals, the second son, Henry Adams, a retired ocean lawyer, who had been a member of the Railway, N. J., attaining to the rank of general manager, received a much larger portion of the land. Mr. Gordon had formerly made his home in it. It was in 1900, when he was 52 years of age, that he lived on his Highway, and in 1902 Mr. Gordon had moved to his home in New York City on friendly terms with Adams and his relatives. The latter, however, had not been in the land had considered buying the Adams' farm for the purpose of enlarging his holdings. But the Adams' had no intention of selling it, and the purchase had never been made. No doubt the invention had changed his mind

But the lawyer, came Henry Adams with a hand-written (of course) draft of a will which, he said, had been drawn by him for his father. He then produced a copy of a draft which Adams presented to the court was, by his own statement, an original rough draft and there were marked upon it many corrections in red ink. Adams said that a clean copy, embracing the red ink changes had then been made and that he had retained the original. This bore the signatures of Gordon and those of Henry Adams, and the signatures of the witnesses themselves as witnesses. But Gordon's copy of this instrument could not be found and his heirs contested the probing of this rough draft. Adams said that he had not had a motive for presenting it, since it contained a clause by which the heirs were to receive the property and that the property had never been worth that sum, it was contended. At the time of the contest, the property was worth \$125,000 and Adams contended that it was worth no more than \$12,000. But Adams persisted, repeating that the will was genuine and that he had no knowledge of the provision relating to his farm.

At this point the astute Dr Carvalho was summoned and asked to put the Adams copy to a thorough test. He was furnished with many samples of George P Gordon's genuine signature and with the true signs of the Adams relatives who appeared on the will as witnesses. Carvalho examined these various signatures and concluded that neither Gordon nor the relatives of Adams had ever signed or seen the paper. His opinion was that Henry Adams had done all the signing himself, using the authentic copies to swindle him.

But the most striking discovery was still to come. Mr. Carvalho noted the interlinations in the suspected will and saw that they had been written in a peculiarly brilliant red ink, having a bronzelike lustre. He went for his chemicals in considerable excitement, conducted a careful analysis of the red ink and discovered that it contained cocaine.

All old fashioned red fink was compounded in which the active color ingredient was cochineal, the dyestuff extracted from a cactus growing in the arid regions of Mexico. It was the basis of most red dye, food colors and fink until 1874 and later. In that year the synthetic dye, aniline, was introduced from coal tar and soon used for fink making. But the process of extraction was at first very costly and it was not until 1898 that the synthetic dye, aniline, was marketed in the American market. This fink was so much more brilliant, easy dyeing and cheap than the old fashioned red fink that it soon gained in popularity. But Henry Adams had, by his own suggestion, written the Gordon will and the red interferences in 1908—1909. The synthetic dye, aniline, was not fink in the American market! His claim was accordingly and emphatically tossed out of court. And his perpetration arrested for

Thus reads the story of disputed documents—just another phase of the constant battle being waged between the criminal and the forces of law and order. In this instance, however, it does appear as though the forces of law and order have the best of the argument in the long run.

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Low cost of maintenance



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The only car in the world that is so easy to learn to operate.

accidental displacements should be provided. The common practice of the average driver of switching off his bright lights in passing another car may prove dangerous in a dark road unless the car is being driven very slowly for it takes the driver's eyes an appreciable length of time to adjust themselves to the new conditions and until such adjustment is made, the driver is practically blind so far as seeing the highway ahead is concerned. Many drivers adjust their lamps so that they will throw considerable light up into the air possibly in order to better see highway signs. All such headlights should be placed at height at which they are readily discernible with headlights that are really satisfactory. The results of the Bureau of Standards' investigation of the headlight conditions of 400 average automobiles are approximately summed up in Underhill's conclusions: (1) Few motorists are making maximum satisfactory illumination service from their headlights. (2) There is a real need for several public education campaigns regarding the necessity for and the means of adjusting headlights. (3) A test screen to judge and interpret and in general the required lamp adjustments are easily made. (4) The installation of an approved device does not in itself mean a safe or legal light. It must be kept in proper adjustment for satisfactory illumination. (5) Illuminating devices with an approved device invariably result in more and better road illumination.

Ball Bearings and How They are Made

(Continued from page 551)

pieces of silver steel can detect instantly by the sense of touch the presence of any undesirable spot in the race. Suitable instruments are relied upon to establish whether or not the ball track is true to form, of correct diameter, and placed exactly midway between the flanks of the ring. Need now to remark, the balls on the rapidly rotating inner or outer ring must be concentric with its neighbor. Apparatus, based in principle upon magnifying collars, gives readings in ten thousandths of an inch. The balls in a bearing are held in their designed positions between a set of rings by means of a special device. Drawing upon the type of bearing, these may be made of white metal fashioned by the casting or they may be worked up from brass tubing fed to automatic lathes. In either case, the product must be formed with due regard to exactness. The final operation in the manufacture of a ball bearing is to assemble its several parts. This would hardly be satisfactory if the rings, like the balls, were not nicely graded according to their refinements of size. This makes, in a measure, for what is termed "selective assembling," which assures perfect fit and the utmost smoothness of running. This characteristic, in turn, contributes to long and successful service.

Keeping Our Water Fit to Drink

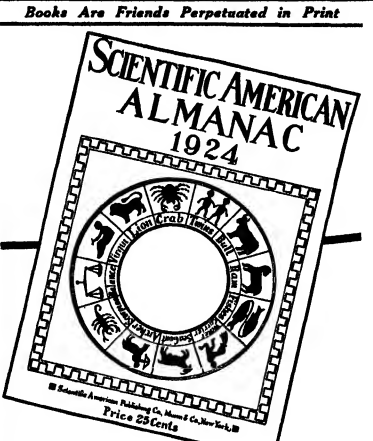
(Continued from page 551)

her of organisms in the water through sedimentation, by the appearance of the organisms under the microscope, the color matter being knocked to pieces, so to speak. Sometimes there is an increase in the water bacteria which food spoils the decayed organisms. The Cyanophyceae may produce even after treatment which is of various colors, pale blue, yellow, red or brown. The usual method of applying copper and lake has been to drag burlap bags containing about 50 pounds each through the water by means of two boats, taking a slight current so as to triangulate the surface of the water. Mud, weeds, diffusion and gravity settle the streaks of treated water by the residual force has been treatments made in this crude manner. On the extensive reservoir of the waterworks (it is necessary to use laundries and in the last few years that portion of Canada reservoir lying between the Indian and efficient gatehouses has been successfully treated in two days time with approximately 6,000 pounds of copper sulfate. This treatment has been made on several occasions at different seasons, including winter. On many other occasions 2,000 pounds have been applied to Ontario Lake and once on Canadian reservoir. In these laundries treatment of long reservoir parallel course about 300 feet apart are usually taken.

Beginning in January 1920 a new departure was made. Copper sulfate was applied continuously for weeks at a time, aggregating three months of the year, to the water in the aqueduct at Pleasantville, about

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Have you the Scientific American's "Ready for Emergencies?" Have you read "Confessions of a Confidence Man" and "Behind the Motion Picture Screen"?

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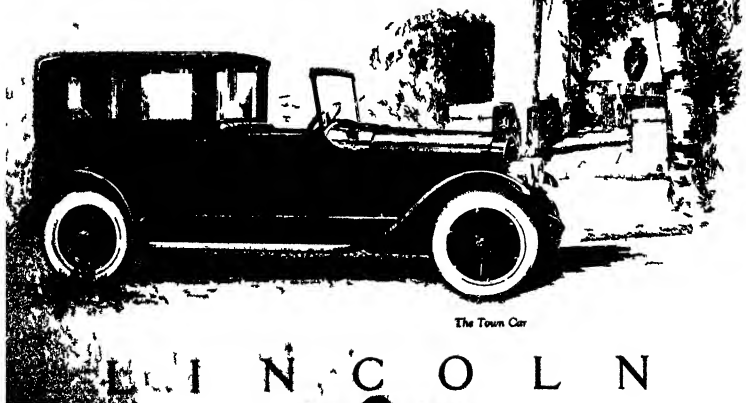
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The respect the Lincoln enjoys among owners of fine cars is based on no single phase of excellence. Impressive as are its several qualities, these alone could not sufficiently account for the universally high estimation in which this car is held.

This esteem goes beyond the technical excellence of the car itself striking as that excellence is. It is deeper than any appreciation for beauty of line and luxury of appointment could make it.

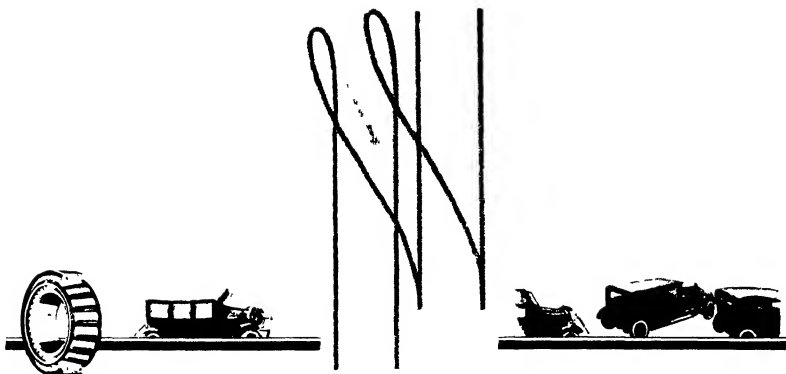
It goes, in fact down to the bed rock of unshaken confidence in the organization behind the Lincoln—of firm conviction that the vast resources available for the purpose are sincerely devoted to making and keeping this car the finest it is possible to build.

LINCOLN MOTOR COMPANY
DIVISION OF FORD MOTOR COMPANY DETROIT, MICHIGAN



The Town Car

L I N C O L N



Can They Park?

Can they easily park the cars you sell?

When — again and again — they must fully swing the front wheels of the nearly stationary car, when adhesion between tires and roadway is greatest, then the less friction in the steering pivots the better that car will be liked.

Steering pivots equipped with Timken Tapered Roller Bearings assure minimized friction always, they withstand the thrust and shock of this location, and they provide the ready adjustability for wear which keeps the steering pivot always snug-fitting and true, but easy to turn.

If traffic conditions today are to any degree a sales resistant, Timken in the steering pivots are distinctly a sales help.

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SCIENTIFIC AMERICAN

The Monthly Journal of Practical Information 3 JAN. 1924

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RECORD-BREAKING ALTITUDE FLIGHT CONDITIONS IN THE LOW-PRESSURE CHAMBER (See page 401)

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The Standard Oil Company use many FEDERAL Trucks



Pittsburgh The + Cities operate FEDERALs successfully



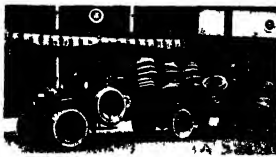
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Twelve Streams from One Engine 1400 Gal./Min. Capacity, Ball Bearing Equipped

TWELVE streams are possible from this fire engine of 1400 gallons per minute capacity. Imagine the headway a fire would make if the pumps on this engine broke down due to bearing trouble—if all the twelve streams failed at one time.

To guard against the failure of this large fire fighting unit when responding to an alarm and when fighting the flames, SKF self-aligning ball bearings are used on the jack shaft of the chain drive for propelling the engine and on the pinion shaft of the pump drive.

Made of chrome alloy steel hardened uniformly throughout, this type of bearing has great endurance. Furthermore it develops no appreciable wear in service even under conditions of misalignment which would cause plain bearings to bind heat and ultimately fail.

Because of their stamina and precision SKF marked ball bearings are invariably preferred by experienced users on machinery of all kinds. Our engineers will gladly submit recommendations for applying ball bearings to your machines.

THE SKAYEF BALL BEARING COMPANY

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Normal View



Defected View

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BEARINGS**
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of the Bearing Principle*

WHERE FINE CARS CONGREGATE

With the advent of each new winter season, the supremacy of Lincoln closed cars becomes more pronounced.

It is not alone that the number of these cars is noticeably increasing. As a matter of fact, the attainment of large production records has not entered into the plans for them.

But the type of service for which they are employed in increasing volume is conclusive proof of their preferred standing in the public esteem. Fair examination reveals that it is the people whose approval is most significant who are lending impetus to the use of Lincoln closed cars for personal transportation.

LINCOLN MOTOR COMPANY
DIVISION OF FORD MOTOR COMPANY DETROIT, MICHIGAN



The Four Passenger Sedan

L I N C O L N
2025

SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, DECEMBER, 1923



THIS designing of motor cars moving on runners instead of on wheels is no absolute novelty in itself. In fact, on perusing the annals of patent offices many examples of schemes such as this could be found, though none of them has got beyond an experimental stage. It was left to a Berlin inventor, R. Vossalt, to perfect the first full-size vehicle of the wheelless type, and as the writer has had the good fortune to inspect it in actual operation, the account given in the following does not tell what is planned for the future, but what has actually been achieved and already is in being.

The new vehicle comprises two pairs of runners three meters long, which, like the four feet of a horse are alternately raised and lowered, the runners of each pair, the outer as well as the inside one, being rigidly connected with one another. Supporting the underframe and body of the vehicle to rest on both pairs of runners, the engine will at first lift the two outer runners, leaving the car to rest on the inside pair, and, after moving it forward a certain distance (1.5 meters), will put them down on the soil, in order, immediately afterwards, to commence the same operation with the inside runners.

The main difficulty met with in connection with any previous attempt to solve the problem was that the pair of runners temporarily lifted from the ground could not be lowered quickly enough, the vehicle being in front of the underframe, to enable the latter to move along uninterrupted and without a hitch. This is for the first time relieved in the new vehicle, where the pair of runners temporarily raised from the ground move

A Wheelless Motor-Car

By Dr Alfred Gradenwitz

forward past the underframe at a more rapid rate than that at which the latter will presently glide across the pair of runners happening to rest on the ground. Inasmuch as the runners actually constitute rails on which the rollers carrying the underframe are gliding, the consumption of energy is extremely low. Actual tests have shown a haul of 6 to 8 tons to be conveyed by the vehicle driven by a low-power engine (25 horsepower) at a relatively high speed, viz. 8 to 10 kilometers per hour, irrespective of any obstacle, e.g., tree-trunks lying on the road. The vehicle, as it were, throws a bridge across ditches, which accordingly are traversed with greatest ease. It will readily negotiate even considerable gradients. Inasmuch as the weight of the engine is of no importance, crude oil engines can largely be used for driving this type of vehicle, thus reducing considerably the working expenses. Rail-trains can be formed of such vehicles, though only the front vehicle need be power-driven.

The vehicle is without any exterior and without the aid of any complicated mechanism steered from the driver's seat by means of a hand-wheel altering at will the angle between the two sets of runners. Any curve can thus be readily described, the vehicle being even turned on the spot, without any forward or backward motion. The top of the car is under way aimed at will between the normal levels of 1.30 meter and zero, thus making heavy gradients to be readily negotiated.

With the cost of construction of the vehicle is only immaterially in excess of that of ordinary trucks, the wear and tear are reduced to a minimum, there being no friction or skidding on the ground. The vehicle will not be especially useful on impracticable ground, as not to be brought under construction.

Charles Proteus Steinmetz

JUST as we are going to press, and late late either for preparation of an extended obituary or for the commemoration of such a notice in our pages already made up, comes the news of the death of America's best known engineer. Dr. Steinmetz was born in Germany in 1865, and received a good education. His Socialist prejudices forced him to flee the country and he came to the United States, without funds and with slight knowledge of our language, in 1880. He secured work as a draftsman under an environment that gave ample scope for his natural design and engineering ability, and his rise to the top of the electrical engineering profession was rapid. He soon came into the employ of the General Electric Co., and for many years prior to his death his name was synonymous with the extraordinary development of organized research and the highest laboratory maintained by that company at Schenectady. Among his peers, he was recognized as the foremost exponent of the union of mathematics and electricity. He was responsible for the modern mathematical treatment of all alternating current problems, and Edison characterizes him as the world's greatest practical mathematician. To the general public he was probably best known for his high voltage experiments,

With Fire and Fraud

Something About the Acquisitive Gentleman Who Burns Buildings for Profit

By Edward H. Smith

IN THE fall of 1788, Captain John Laney was ordered to proceed from Bliddeford to the Colony of Maryland, with a ship full of brimstone. He was a most successful trader, dropped lightly down the desolatory Torridge and headed into the mysterious West, that region of unknown and unexplored malice. At sundown the young skipper stood on his bridge quaking over the strange episode that held him, looking forward toward the Columbia he would never see and back at his England, fading in distance and dust.

At 8 o'clock there was an explosion below decks. The upper parts of the vessel fired like straw. Below decks the infernal sea flowed in, through a great gash the powder had opened in her belly. The cargo of bricks here was swiftly down. No pump might hope to keep such a wreck afloat till dawn.

After some agonies, Captain Laney got the boat launched and all hands safely aboard. They reached England the following day and Laney reported to his brother-in-law and employer, one Hanson, then sitting in Parliament for Barnstable. Hanson sent his captain to a prosecutor, before whom the master swore that the firing had been accidental and that nothing could have availed to save the ship or her cargo. Hanson left England for a round voyage. Captain Laney stayed behind.

A little later, through the tattle of some idle tongue, the captain and his rich relative became suspect and investigation showed that Hanson had taken his ship with a cargo of merchandise for America, insured the vessel and her contents for twice the honest value and later secretly had the goods removed and the ship filled with bricks for sale. He commanded Captain Laney to take her out to sea and set her adrift. The young man declined until his relative pointed out to him that it was within the latter's power to discharge and beggar the seamen. Then Laney began setting fire to his own ship under the feet by means of an explosive mechanism which rapidly spread the fire.

A few sentences from that treasure house of bitter recollections, Camden Pelham's "New Narrative Calendar," will complete this tale of early commercial arson.

"His employer, first, and his unhappy doom befell through a fire, was capitally convicted and received sentence of death. He subsequently lay in prison for about four months, during which time he pursued his devilish exercises with the utmost regularity, and was hanged on the 7th June, 1784, at Execution Dock, in the 27th year of his age."

If I recall this old crime and melancholy destination it is surely not to hold poor John Laney in a pitiless extension of impure memory or to expose his name to further obloquy, for he was, in the New Narrative Calendar, vigorously acted, respectably connected and even gently born. My purpose is rather to show the antiquity of arson for profit, a kind of crime now offering both the police and the inventors of this and every country one of their most new afflictions. The suggestion is not that John Laney was the first man to burn a house or a ship to get the insurance. Indeed, this crime must be as old as insurance, which is not much younger than trading. Commercialized fire insurance sprang up after the great London fire of 1666, though the guilds had provided similar protection much earlier, and, more than thirty Shakespearian Attellos came into the Bay back a grip through the need of a premium for marine insurance—to cover those hapless Argosies in Tripoli, India and Mexico. So, Laney is but a reminder.

In beginning to write of fire as a criminal instrument, some flames and stragglers are to be noted. First, the one pure element of the alchemists, employed for dual purposes, fire, the source of light, in the service of the forces of darkness; fire, the great agent of the alchemists, by which man was to gain the secret of high fortune and lasting life, used to spread ulcers and death, the deadly disease of the alchemists, Rodolphe of Panoplia and Paracelsus Holsten-helm in the hands of Benny de-Bake and the Pirebag Kid.

The diabolical conflict between man and his Prometheus friend and Stalemate enemy began in the bon-fire-pretence where the deerskin and the joints of the animal roasted prey, or in the vanished forests that burned and consumed wandering tribes of hunters in ages forgotten and lost. It continues in the age of concrete and steel

To guard against this fire-rioter, men have made ten thousand experiments and inventions, meantime employing him for their power and their researches.

In no brief or casual manner can I point out only a few of the important inventions which men have wrought to protect themselves against fire in its destructive mood. When this writer was a child he was taken to a building in Chicago where a great fire had been set in one of the rooms and permitted to burn for hours as a demonstration of the first fireproof hotel. Some what later, also in Chicago, a theater disaster brought



Firemen working on an incendiary fire in a city dwelling house

about the installation of asbestos curtains in theaters and the general adoption of fireproof construction. Since that day many other installations have been made, all steel reinforced coaches and sleeping cars, great buildings without an ounce of inflammable material in their structure, automatic sprinkler systems for flooding buildings with water at the first outbreak of fire, other automatic systems which sound alarms when any fire breaks out, steel, glass and porcelain office furniture, special insulation to provide against fire from electric wiring, etc. In spite of all these improvements and steps of progress, America remains worse afflicted with fire losses than any other western land, a curious fact which the deerskin and the joints of the animal roasted prey, or in the vanished forests that burned and consumed wandering tribes of hunters in ages forgotten and lost. It continues in the age of concrete and steel

Just why fire should be so prevalent in America is

difficult to say. Authorities disagree and founder. All we can know definitely is that a tremendous struggle is in progress in this country between destructive fire and the agencies of defense and prevention. Fire insurance companies have naturally taken a leading part in this effort to reduce the fire loss. Their strength has been expended in combating the accidental fire, the fruit of carelessness, forgetfulness and stupidity in man.

But there is a far deeper and darker struggle than this going on between civilization and withering fire. Like every other tool which honest men have used for the advancement of civilization and social order, fire has been and is being used every day by criminals. Poor John Laney is abroad in the land, converted into a professional fire setter, an arson specialist. He is in all communities. His ruin monument every townsite in the land.

The story of the fire-setter is of itself an old and stale one. Purposeful fires among merchants became a common fact before the birth of any man now living. We all know how old and simple a thing it is to insure a \$6,000 stock for \$6,000 and shortly set the match. But such tricks have become more and more difficult since the insurance companies and the various associations of creditors have come to realize their own peril and the methods of fire setters. Insurance investigations are now remarkably rigid, whereas they were once pitifully lax. The action of creditors in this, particularly among the fire insurance companies, is to be slow and easily exhausted. In brief, the firebugs are now being resisted and punished. The result of strict action has not been to drive them out of business but to sharpen their wit and stimulate their inventive facilities. How to set a fire and not be caught at it? This is the chief preoccupation of a large and growing class of criminals against whom no really effective measures have yet been devised.

The rationale of commercial arson needs to be understood. It has often been said that firing sidestepped fire in false bankruptcy cases. The truth is otherwise. If a crooked merchant wants to go fraudulently broke and thus cheat his creditors, he must get rid of his goods somehow. To remove and hide them, thereafter claiming bankruptcy, is the simple course, but a search is always made. Many crooked merchants consider it far cleverer technique to burn out their nearly empty stores after the valuable part of the stock has been secreted in that case the creditors seize the insurance money, but what matter to the thief? He has his goods. Why should he care if the loss is shifted from the shoulders of those who trusted him to the backs of those who insured him? Nevertheless, the fire insurance companies are over-insured. In that case the creditors get what's left of the insurance money—first-mortgage money—the balance, plus the hidden merchandise. In still other cases no creditors figure. The arsonist has simply disposed of his peddle-goods and then burnt out his shell of a store.

In every case where arson is committed the problem of safety for the criminal plays a leading part. How to set a fire that will burn so swiftly and hotly as to destroy all evidences of arson before the fire fighters can possibly question it? How to smash out of business the persons interested in the insurance are dangerous far away? How to do this without the employment of trustworthy accomplices? These are the questions which always face the fire setter. How he meets them is the heart of this matter.

It is an indictment for much of our material to that most eminent authority on arson and credit frauds, Mr. C. D. West, at present president of the National Association of Credit Men. Mr. West has been a very expert arsonist and solved more strange fire mysteries than any other man in America. He is now and accurately occupies a special position in the world of crime suppression.

One of the recent devices employed by mercantile fire setters was recovered from a store in downtown New York not long ago when a watchman in the building made an unusual inspection and found the infernal machine before it had had time to do its work. It consisted of the shallow round top of a better tub. This with the deerskin and the joints of the animal roasted prey, or in the vanished forests that burned and consumed wandering tribes of hunters in ages forgotten and lost. It continues in the age of concrete and steel

outer edge of the motor had been tacked twelve or fifteen little upright pins, the ends of each supporting a small bladder of very thin rubber. Each of these little bladders was filled with a few or six ounces of gasoline and tied shut securely. The smaller fire machines have been found in which one or two cow's bladders had been used, each laden with three to four quarts of the popular motor fuel.

The theory of this mechanism is simple enough. The candle in the center had been lit a length which would burn for nine or ten hours before reaching the oil soaked cotton wool. It had been lighted at six o'clock, when the Italian had closed his door and gone home for the night. It would do its deadly work between three and four o'clock in the morning. As soon as the candle burned itself short enough to set off the cotton there would be a considerable flame. This would heat the gasoline in the little bladders. In a few minutes the expanding gas would burst the bladders and throw the flaming gasoline to all parts of the store.

Flames would thus spring up in a score of places at once and the explosion would surely destroy all vestige of the mechanism. To make sure of the work's success, the floor had been soaked with gasoline at various points and the part of the store nearest the pyrotechnic mechanism had been heavily draped with kimonos, lace curtains and other highly inflammable materials. In this single case the firebug failed in how many others it did not succeed!

In one of the upstairs rooms the fire did succeed! York, not long ago, an Italian grocer and general merchant occupied the ground floor of a frame building at the outside stairway ran to the second floor, where a Syrian artist lived with his wife and children. In the basement of the premises was an old fashioned bottle-warehouse, the pipes from which ran to register the gas in the floors.

A little after eleven o'clock, on a cold night late winter, the wife of the Syrian living in the upper story awoke from the sound of a fire alarm, to find a strong odor of gasoline. She hesitated for a few minutes, but as the odor grew in intensity she called for her husband and her clothes and started for her husband who was at a late meeting two or three squares away. Just as she opened the door he came in and recoiled from the gas. He went downstairs immediately and, not without some suspicion, forced his way into the Italian's grocery store. Just as he did so, he saw a shadowy figure retreat to the alley and drive off in a motor car, which had been standing close by with lamps out.

Inside the store the Syrian found a five-gallon water cooler standing on a shelf, with the spigot turned on, so slightly open that the contents dripped from it drop after drop. Underneath this device were piled two cases of parlor matches with a gross of large boxes in each. These matches were already wet with gasoline dripping from the water cooler. In the center of the floor stood two palmetto tins which were half filled with gasoline. Not less than five or six gallons of inflammable had been provided for the fire.

The Syrian turned off the gasoline dripping faucet of the cooler, opened the doors and windows to allow the exhalation of the gas and set off for the Italian's home, some distance away. To his intense surprise he found a celebratory going on. The Italian's lady was being christened, and among the guests at the party were the chief of police, several city officials and some politicians, among whom the Italian grocer ranked himself. The grocer tried to put the Syrian off. First he said the thing could not be true. Finally he insisted he would not leave his lady's christening because a little oil was leaking. Then he said he had given the keys to the lady and they had gone. Finally he said the Syrian appealed to the police chief and that official decided that his public duty was somewhat more urgent than his moral objection to the Italian's shop. The man extricated matches, the water cooler still half full of gasoline, the tins of inflammable liquid on the floor and a gross argument of materials for a quick, disastrous fire.

Undoubtedly, had the Syrian and his family been in their beds on the upper floor when the crash came, they would have been blown to kingdom come. The Italian had expected the furnace in the basement to cause the conflagration, as soon as the gasoline from the

the water cooler had dripped through the floor and formed a gas. But, to make doubly sure, he had sent his brother to throw some oil of burning stuff into the store. This was the man who had been sent sinking off to the mount of sin in the afternoon. The stores were naturally committed to Anshur, where they still abide.

Because of the scientific recognition of the fact that fires may originate spontaneously, in certain materials under special circumstances, and because of the wide publicity of the recent spontaneous combustion many efforts have been made among fire setters to simulate this natural phenomenon. Where such work is well off the effects of fire setters are not so great. The spontaneous combustion is, therefore, popular among the professors of arson.

One method of simulating a natural outbreak of fire is as follows. The fire setter takes an old barrel and picks it half full of oil waste, with a tiny spark burner in the middle. He then packs the barrel full and tight with old clothes, greasy papers and other materials of this sort. The little fire in the center of the greasy waste will smolder for six hours or six days, according to the closeness of the packing. Finally, how ever, it will burst into wild flame and set off anything he made.

Such spontaneous combustion barrels are often employed by dry goods and clothing merchants. The barrel is prepared with its spark and put into the rear of the store, where windows are kept open to carry off the

the insurance inspector, the crooked merchant, the expert fire-setter and the fire insurance agent who has no other way to have a fire. He resorts to the crooked agent who writes him a policy for far more than the value of the stock. The crooked insurance agent gets the property, blinds his eyes to the fraud and approves the risk. In a little while the professional arsonist comes along, removes as much of the stock as he can, saturates the place, sets a pyrotechnic bomb of some sort and burns up the merchant's store. The business man is always away on a short vacation when such a blow is produced. He comes back with great clarity, however, and his first act is to call for a howling complaint to the insurance agent. Now the interesting part of the comedy is played.

He rushed to the fire insurance office, the policies, sends the claim to his company, with the recommendation that it be paid, as the loss is complete and the merchant a worthy man. The claim is sent to the adjuster, who proceeds to make an examination. His business is to find fraud if any exists, but in this case he makes it his business to overlook any that he may find. He reports to the company that the fire was bona fide, that the loss is complete and that payment should be made. The merchant gets his money promptly and divides with the other members of the ring. Simplicity and precision are the virtues of this plan of action. It is applied in many other types of insurance.

Sometimes the romantic and extravagant enters into his dealings of the arson committee and lights this dark subject with a flare of internal story. The story I have to relate in this connection has been told by me before and by others, not too scrupulous about literary propriety.

A few years ago a boardwalk show dealer in Atlantic City, named with a large stock of exotic merchandise, Mr. West, went to find the abductor and his accomplices, found among the few papers left behind by the vandals, a bill for a dozen animal skeletons. He could not imagine what a smart show shop might want with animal skeletons until he discovered that they had been twiggled to the address of a man of the same name as that borne by the show merchant, in a small Pennsylvania town. The investigator hurried thither and found that the resident of the animal shop was in fact the father of the vanished show merchant. Let us call him Schwartz, since that was not his name. The elder Schwartz had been a successful show merchant, had suffered several fires, all of them disastrous to the insurance companies and had finally retired. His son had then entered the business and his results already noted at Atlantic City.

Mr. West knew at once that the elder Schwartz was the man to be approached with caution. Accordingly he began his campaign by indirectness, asking questions here and there among better known showmen. Finally, he discovered that Schwartz was supposed to be an animal trainer. He then pointed this. The adjustment of animal skeletons to the show business was a watching and questioning divided the investigator on his course. He went away for a time, only to reappear in the garb and person of a circus man. In this character he called on old Schwartz and was most cordially received. But his real business was to get into the house. Only the fondness of the old man rendered this phony trumping possible. In the kitchen Mr. West found a specially fitted coat of arms. A little more and it showed two cats. One of them got up as he came in, arched her back lightly, lifted a paw and pulled the short chain of the gas jet lighted by the small pilot. I suppose every reader will be familiar with such gas lighting apparatus.

West needed to know no more. He understood that old Schwartz was training cats for arson. A merchant who wanted a fire brought one of the cats and had a gas jet lit in the room, preferably in the kitchen. A little pilot, which burned day and night, set off an ordinary gas jet. The cat, which had been trained to this device, then assumed herself as a training cat, turned the flame up and down as old Schwartz and taught her to operate the gas jet. The show merchant removed the lip from the gas jet and when puffed pulled the chain a great flame sprang up lighting inflammable which was piled above it.

(Continued on page 377)

The interior of a store after a conflagration of suspicious origin

odor of the smudge. The ancient knows, of course, how many hours must elapse before the flames turn. Usually he waits for a weekend. He closes his shop at dusk on Saturday and goes about his pleasure. He has not, of course, forgotten to sprinkle a good bit of gasoline about near the smoldering barrel. Neither has he neglected to hang up coats, dresses, curtains, wrappers and all sorts of loose commodities where the fire flames will reach them.

Thirty odd hours afterward, the smolder in the barrel breaks into brilliant flame. The fire spreads quickly to the inflammable material about the barrel. The fire machines can arrive from any distance, the whole place is an oven and when the water of the hose finally makes control of the fire the interior of the store has been an enormous barrel. It is then possible to determine whether the best merchandise of the place had been removed in advance. In one the fire is found and got under hand before it has a chance to fare up well, the origin of the blaze must be found in a barrel of waste and only the expert will suspect that this commercial thing was a work of art.

But the individual fire setter is no longer so great a success in one way. The big and successful ones of this kind are the work of the fire insurance agent, by organized gangs or arson rings, as they are called. The chief of the fire insurance agent is the work of the fire insurance agent, by organized gangs or arson rings, as they are called. The chief of the fire insurance agent is the work of the fire insurance agent, by organized gangs or arson rings, as they are called.

The arson ring consists of the fire insurance agent,

The Fuel of the Future

The Advantages of the Universal Burning of Gas, and the Obstacles in the Way of Its Attainment

By Ismar Gunsberg

WHEN the paleolithic man discovered fire and learned that the earth about him abounded with matter that could be burned and in burning could furnish him with heat not only for bodily comfort in the cold of the winter, but also for subsisting, tanning and weapons and for cooking his food, fire first assumed its position of transcendental importance in human affairs. This position has gradually developed into one of even greater significance as society grew more complex and the arts and sciences of civilization were evolved until today fire is undoubtedly the most important single commodity employed by the human race in their homes and industrial life. Fire is the sine qua non of modern civilization. With out it, there could be but little of the comforts and luxuries of life, industrial enterprise would be practically nil—in fact, society, as it is called today, could scarcely exist. It is everywhere and in all stratum, when disruptive forces, such as strikes, make their appearance in the news of the day, that each and every member of society should become greatly concerned over the matter, and in view them as blows directed against the very foundation of the structure of modern life. A greater truth cannot be taught than the sudden shutting off of our supplies of fuel.

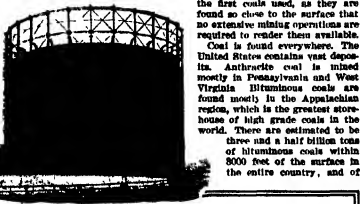
A fuel is a substance which, when it is converted into heating power, electric power or energy in relation with the fuel is brought to the proper temperature and burned. It is well known that all fuels do not burn with the same degree of readiness. Thus, while a piece of paper can be ignited by the heat of a burning match and slowly the stream of gas issuing forth from the gas burner, nevertheless wood must first be heated upon a paper fire before it will itself catch fire and burn. On the other hand, coal is still more difficult to burn, and a wood fire must first be built under the coal so as to bring it to the burning temperature before it will ignite. It is also known that the different varieties of coal burn with different degrees of ease, soft coal burning more easily than hard coal. In burning simply a rapid union of the carbon and the hydrogen and the various other elements, as they exist in the constituents, with the oxygen of the atmosphere. The products of ordinary combustion are water vapor and carbon dioxide, when the combustion is complete, with more or less carbon monoxide in place of some of the dioxide, when it is incomplete.

Coal is the product of the partial oxidation of vegetable matter under great pressure and in the absence of sufficient air to cause its complete destruction—a process extending over a period of a million years or more. According to the duration of this process, various kinds of coal were evolved. Thus the oldest form of coal is called anthracite, a product in which there is practically no volatile matter, almost all the combustible matter being in the form of a hard, compact mass, fixed carbon. Anthracite is sometimes called stone coal because of its hardness and difficulty of ignition. It is the coal that gives very little or practically no smoke on burning. That is why it is used in domestic furnaces in cities for heating purposes and in making hot water.

As the age of the coal decreases, it becomes softer and richer in volatile constituents which produce smoke when it is burned. There is a vast intermediate grade. There is a semi-anthracite, and in comparatively large amounts in this country, and almost as useful for domestic use as anthracite. Then there are the semi-bituminous coals, and the bituminous and the sub-bituminous coals. The bituminous coal is the most important of all for these are the coals of industry. The coal that is used for gas making (gas or cooking coal)

belongs to this class. A still younger coal is lignite, or brown coal. It is a substance that has not been subjected to so complete a decomposition as real coal, and hence it does not possess the heating value of the latter. Finally, there are the peat coals, which contain very high percentage of moisture, and which are not of any great technical or industrial importance. From a standpoint of usage they were probably the first fuels used, as they are found so close to the surface that no extensive mining operations are required to render them available.

Coal is found everywhere. The United States contains vast deposits. Anthracite coal is mined mostly in Pennsylvania and West Virginia. Bituminous coals are found mostly in the Appalachian region, which is the greatest storehouse of high grade coals in the world. There are estimated to be three and a half billion tons of bituminous coals, within 8000 feet of the surface in the entire country, and of



MUCH has been said, these twenty years of raising fuel prices, about the fuels of the future and even about the fuels of the present. The time has come when the public angle of the case in which far too little attention has been paid. Mr. Gunsberg reminds us that all fuel—coal, wood, oil or what you will—must be vaporized before or during combustion. He points out the inconceivable fact that commercially solid or liquid fuels as gas fuel can always be done more cheaply and more efficiently on a large scale in a special plant than on a piece-meal basis in the consumer's old stove or furnace. Ergo, he tells us, the fuel of the future is unquestionably gas, and the gas tank which adorns this box ought to be the universal symbol for heat, light and power. To which we can think of only one rejoinder—Why not?—The Editor

this total, half a billion tons are found in that section. There are also large deposits of soft coal in the West. Lignite coal to the extent of one billion tons is found in North Dakota, Texas and Arkansas. Wood is also a solid fuel, but it does not possess any great industrial importance. The only other solid in-

able for domestic use under the proper conditions and is also valuable as an industrial fuel, besides its application in a particular form, known as coke, in the manufacture of steel. Coke is preferable to soft coal for a hot burning soft coal it is very difficult to obtain complete combustion. This fact is substantiated by observing the condition of the chimneys or stacks in any plant or building in which soft coal is being burned. The atmosphere surrounding the chimneys are a clear indication that a good percentage of the coal, as much as 10 per cent or more, is being discharged into the atmosphere as unburned carbon. Coke burns without smoke, the smoke and other products which are developed in the burning of soft coal in the furnace, and are thereby completely lost, are conserved and employed to useful purposes when the soft coal is first converted into coke in the by-product coke oven. In former days coke was made in beehive ovens and these valuable by-products were wasted. Today there is almost four times as much maintenance in the by-product ovens as in the beehive ovens, and great quantities of gas and other valuable by-products are recovered.

There was a time when by far the largest part of our fuel was solid, and sayings like "was more or less of a break." Today liquid and gaseous fuels are used on a large scale. The principal liquid fuel is gas oil. This is used in the manufacture of gas, to bring up the heating value of the gas, distilled from coal, so that it meets local specifications. Crude petroleum is also used as a fuel. Naval vessels and the merchant marine ships use oil in preference to coal, and it is becoming more and more commonly and burned with a greater degree of ease and efficiency under the steam boiler. Fuel oil is also being used in the manufacture of gas. To produce fuel oil, it is necessary to employ storage tanks and pumping, atomizing and air-mixing apparatus. The price of gas oil is high, and the demand for gasoline, which is ever increasing. One factor that has a material effect on the quantity of gas oil available for sale is the development that has been taking place in the production of gasoline by the cracking of the higher-boiling-point constituents of petroleum. The newest improvement along these lines is a process of cracking oil which will give a yield of gasoline as high as 80 per cent.

The gaseous fuels comprise not only the gas that is used in the modern kitchen, but also the various modifications of gas that are used in industrial processes, such as producer gas in steel manufacture, oil gas for smelt lighting installations, etc. We are concerned primarily with the use of solid fuel, but it is a fact, as mentioned under the one heading, city gas. Both are made from coal—the former from the distillation of the coal, and the latter in the absence of air and the latter by blowing steam through a bed of incandescent coal. Neither has the high calorific power that is demanded in most cases, and hence gas oil must be cracked, and the gaseous products mixed with them in order to make a mixed gas of 800 or 900 B.T.U. per cubic foot.

In considering gas as a fuel there are a number of fundamental principles which must be explained before a clear understanding of its value can be had. When a substance burns, it is first transformed into gas and then the gaseous fuel is burned. This is an undeniable fact and can be proven to anyone's satisfaction by a simple experiment.

A piece of paper is rolled up tightly in the form of a tube. In considering gas as a fuel there are a number of fundamental principles which must be explained before a clear understanding of its value can be had. When a substance burns, it is first transformed into gas and then the gaseous fuel is burned. This is an undeniable fact and can be proven to anyone's satisfaction by a simple experiment.

Making gas. The charging machine in a horizontal retort house

dustrial fuel of noncommercial significance, besides the coals and the artificially prepared products that are made from them. Fuel and tar, known as briquetted fuels, in coke. Coke is a product that is obtained when coal is distilled to produce gas, ammonia, tars and other products. Coke burns almost like hard coal. It is suit-

Three Wheels Versus Four

The Direction in Which the Development of the Economy Car is Pointed

By R. M. Sanders

IN KERRY man's inner wit from childhood days onward lies the desire to own a means of locomotion. Yesterday it was a horse and carriage, or maybe a dog sled, and today an automotive vehicle of some description. Millions of automobiles have been produced, and still there are more people waiting than riders. Many people are in a position to purchase automobiles, so far as the original cost is concerned, but the fundamental thing is the small-income earner's inability to afford to operate even the lowest priced automobile on the market today. People therefore have become motorcycle and sidecar owners.

The motorcycle and sidecar combination is very economical to operate. We can easily realize this if it is possible to get from 50 to 100 miles per gallon of gasoline and 2000 to 3000 miles per gallon of lubricating oil. Then, again, there are but three tires against four on the automobile, without considering the fact that those three tires wear less than the automobile. The question of garage rent enters into the cost of those who live in the city or town and do not own their own garages. The lowest rent per month for the smallest automobiles is approximately \$15 to \$20, against the motorcycle and sidecar combination of \$4 to \$5 per month. It is readily seen from the above figure that the cost of operation of the motorcycle combination is far less than operating a small automobile. The wear and tear (cost of replacement parts) is also in favor of the "combination," due to the fewer wearing parts on the motorcycle.

To satisfy that "inner self desire" of owning an automotive vehicle, and yet to be able to operate one within their income without sacrificing other necessities, many people have purchased "combinations" in order to get out on the highways and byways of the country. (Though it must be said that many purchase "solo" machines (motorcycle) from a sporting viewpoint. Unfortunately, after acquiring a "combination" we find that ordinary every day clothing is unsuitable for all-day traveling on this type of vehicle. It is found that we must have special clothing or wear the oldest tags one may have. This applies to the guest who rides in the sidecar as well as the driver, but this is ordinarily considered trivial when you have the will and the desire to own a "combination" "see America first."

A boon to small income earners would be in their ability to purchase a three-wheeler, such as is being made in a factory in England. A three-wheeler is a light car (if you care to call it that), light in weight practically. It is called a three-wheeler although by the fact that it has but three wheels. The same number as a motorcycle, but sidecar, but of much different design and arrangement. The outstanding advantage of the three-wheeler over its predecessor, the motorcycle and sidecar combination, is its comfort. The three-wheeler has a full seat upholstered the same as an automobile and wide enough to accommodate two people comfortably side by side. The body can be noted from the illustration, is built along automobile lines. The springs of some of the three-wheelers ahead are of the half-centimeter type both front and rear. Naturally, the comfort of riding in a three-wheeler is a real spring-chassis and in a roomy body is incomparable to the "combination." The driver of a "combination" usually the owner, has some of the comforts that his guest enjoys riding in the well sprung and luxuriously fitted sidecar. In the three-wheeler both rider and driver are equally comfortable.

Anyone who has experienced the discomfort of being suddenly overthrown by a rainstorm while driving on a motorcycle and sidecar will realize the advantage the three-wheeler has over the combination. The sidecar is usually fitted with a windshield and up, but is fair to the owner's eyes. It is in the open, subject to ravages of the elements! It is possible, of course, to keep comparatively dry in a motorcycle if the rider dresses like a deer, but driver but who wants to do that? As it is, one has to wear old clothes or

purchase special clothing. Whereas, when driving a three-wheeler, one can put on "Sunday-go-to-meeting" clothes and still enjoy the open country. Then, but would be encountered, both riders have equal protection from the elements.

Sociality is a strong point in the favor of the three-wheeler, for it must be admitted by the most enthusiastic "combination" owner that it is exceedingly difficult to carry on the passenger seat. The three-wheeler affords the fair rider of the sidecar. The fact that both the driver and the passenger are afforded equal protection from the elements and are seated side by side tends to make the longest journey a pleasure under the worst conditions in a three-wheeler.

Riders of three-wheelers are never conspicuous through difference in dress when attending a gathering or at the theater, for they are able to ride in these various places without the necessity of changing their riding upon arrival, whereas the "combination" rider has to.

The components used in the construction of the three-wheelers are similar to those of the motorcycle. The engines used are mostly V types, of the same cubic displacement and general design, the only variation being in the placing of the clutch at the engine instead of at the rear of the machine. The cooling systems of the engines used abroad are equally divided between the water-cooled and air-cooled V engines. The clutch of the three-wheeler and the motorcycle are of the same size and capacity, for both engines are of the same displacement. The transmissions have approximately the same number of gears, though three-wheelers are equipped with three-speed gear boxes, two speeds forward and one reverse, whereas the motorcycle has forward speeds only.

The final drive is exactly the same as a motorcycle, as both drive via roller chain to a static rear wheel. The brakes are also similarly located and retained, one contracting and one expanding, acting on the rear wheel. Some of the three-wheelers are fitted with front wheel brakes as well.

Let us now make a comparison of the cost of operation between the three-wheeler and the motorcycle and sidecar. Although the three-wheeler is a much more costly machine to purchase, it is logical that the cost of operating the three-wheeler is no more than the motorcycle combination. In fact, we have proved that the cost of operating is less than the average motorcycle combination. The three-wheeler holds a record in England for economy both in passenger and in oil—gas consumption of 67.1 miles per gallon (British Imperial gallon) and 2500 miles per gallon of oil. The cost of oil is also less than with the "combination." With increased utility and low cost per mile, the three-wheeler is the most economical vehicle in operation.

When taking a general view of the three-wheelers from an engineering standpoint, we find that it indicates merely a rearrangement of the components to make use of the maximum power available to produce the greatest results.

In comparing the power application of both vehicles, let us suppose for example that the engine of a box is moved. It is most likely that we would push at a point in the center of the rear of the box, to move it forward with the minimum of effort. It is only evident that we would not push on one of the corners and expect it to

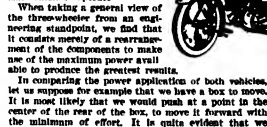
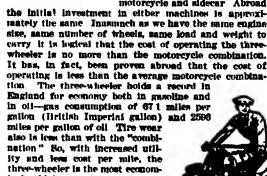
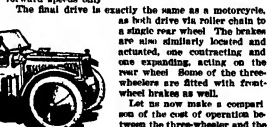
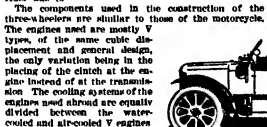
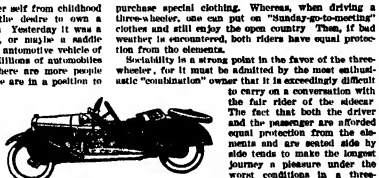
move forward without also using some additional effort to keep it in a straight path.

The foregoing paragraph emphasizes the improper application of power to a vehicle having three wheels, when the power wheel tracks directly behind and in the path of another wheel. The arrangement of the wheels as used in the three-wheelers should be two wheels in front (used for steering), with power wheel placed directly behind the lead wheel and not on the centerline drawn between the two front wheels. By so placing the driving wheel directly behind the lead wheel the vehicle is moving in a straight line. This tendency of turning necessitates the holding of the front wheel of the motorcycle over in the opposite direction to overcome this tendency, thereby causing undue wear in the front tire of same. Naturally, this tire wears more than it would if it could travel in a straight line with the rear wheel of the motorcycle. Again the three-wheeler scores.

Although the three-wheeler weighs slightly more than the "combination," from an engineering standpoint it is exceedingly far in advance of the motorcycle and sidecar with a great useful load and available power. The three-wheeler is not only logical, but it has been proven, that the three-wheeler is more efficient than the "combination."

The three-wheeler was made on a small-scale production in 1910 and first exhibited at the Olympia (English automobile show) that year. The pioneer firm is still going strong and its product has increased in demand as the three-wheeler industry grew. There are today in Europe seven manufacturers of the three-wheeler, which is a proven vehicle abroad. There has been very little change in general design during the past ten years. The important automotive developments in reference to engines and other components have been adapted to the components of this vehicle as well as the other automotive vehicles. Abroad we find that most manufacturers of three-wheelers and motorcycles purchase their engines, transmissions and other components from parts manufacturers. The same conditions prevail in our automobile field, which has proven so successful through the standardization work of the Society of Automotive Engineers. It was not until the early 1920s that the three-wheeler should play an important part in three-wheeler program. The three-wheeler, in competition with the motorcycle combination and four-wheelers, has won more than 20 gold medals and 15 silver medals in tests. This includes speedways, hill-climbs, and endurance tests (machines driven by owner-drivers) and factory machines. They hold the economy record of 67.1 miles per gallon, also the speed record of 100 miles per hour in per hour. In Britain and on the Continent, many general competitions are open to the three-wheeler, and special classification for them. The European automobile journal is a constant reminder to the rest of the readers in this type and its future. Distinctly it ranks as a small car, not at a motorcycle, both in England and on the Continent.

The three-wheeler has a definite place to fill. It will ultimately replace the motorcycle and sidecar, which is a costly and uncomfortable means of transportation. The public has never demanded any new machine before it was displaced and demonstrated. Once the three-wheeler is introduced into the United States it will be possible for the small-income earner to satisfy

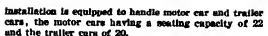


that "innermost" desire to own and operate an automotive vehicle. There are many people in this class to whom the "combination" appears dangerous and mysterious, due largely to the exposed units and necessity for special clothing. It may be predicted that the three-wheeler will recruit many more enthusiasts than the "combination," including a large percentage of the present "combination" owners.

The three-wheeler has one outstanding advantage which the motorcycle, with or without the side-car, can never meet. It can carry a battery and self-starter, and it has the reverse speed in its gear box. The absence of these makes the motorcycle fundamentally unsuited for general use by all members of the family but the three-wheeler is just as easily started and just as easily maneuvered out of a tight spot by the weakest member as by the strongest.

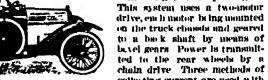
Gelatine to Eat and Gelatine for Glue

IN our October issue, in his article on curfews foreign foods, Mr. Lodian permitted his appreciation of a curfew to lead him to state his disavowal and to explain his belief to the facts. Mr. Lodian, in speaking of Dietz's gaitheer before the well-known "cave of old bones" as the raw material from which this product is made, as anybody familiar with our pure-food laws would realize, such a connection with the gaitheer would be unable to get past our curfew as a food product. The fact is, as the leading inspectors of the Food and Drug Administration, there are two grades of Dietz, one being for food and the other for glue. In Dietz, as everywhere else, the two are kept quite separate. The glue is made from the waste of the edible gaitheer, without concern as to its origin. It is a matter of regret in the REFORMER AMERICAN that Mr. Lodian, in his article, failed to make this distinction and made a statement implying otherwise, and that this statement should have slipped past the editorial board.




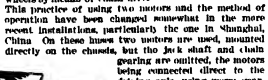
The Florio system, which is in operation on more than 40 miles of route with eight different companies, has proved very successful. This system ad-
 vances to a two-motor drive, in which each motor is mounted on the chassis and geared to a back shaft on which is mounted a sprocket wheel. Transmission of power to the rear sprocket is by means of a chain drive. Each car is equipped with two 12-horsepower motors. The collection used are similar to those described with the Mifflin City System, except they are connected to the bus proper by means of a rigid pole.

The Mifflin City system has been employed extensively for the collection of passengers and freight service. There are eight or more installations, three of which are strictly passenger service, four are entirely for freight and one handles both passenger and freight.

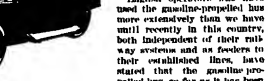


this system. 1st two trolley poles under running on the trolley wire. 2nd, one trolley pole with a double band carrying two trolley wheels, 3rd overrunning carriage as described under the Mercedes Stoll system. This last method of collecting current has not produced good results, due to the damage resulting from the carriage's leaving the trolley wire.

English practice differs somewhat from any of the three systems previously described. Two motors are used, each being mounted on the truck chassis and connected to a jack shaft through worm gearing. The jack shaft carries a sprocket wheel and power is transmitted to the driving chain by means of chain drive.



driving axle, using worm gear-



developed, cannot be operated at the same cost as the street car, and that they are not well adapted for handling peak loads, but they have found the gasoline bus well suited to operate as feeders or to connect up

existing street railway routes. The Paris transportation system is now operating trolley buses in extension of trolley lines.

in rapidly growing suburban sections. In the United States and Canada recent installations have been made at

Staten Island, New York City,
Baltimore Md., Richmond, Va.,
Minneapolis, Minn., Los An-
geles, Cal., Toronto and Wind-

World Revolutions

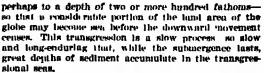
THE land surface of the globe has been, for the most part many times covered by the sea

in the course of geological time
The mountain ranges of the
earth, as now known, have only recently attained their


present elevation, other mountain ranges formerly existed which have now been all but obliterated by the remorseless effects of long-continued denudation.

It is important that we should study for a little what happens when a great mountain range is developed on the surface of the globe. There is a long period of preparation for the state (event), a period many millions of years in duration. First, there are signs of unrest in the solid land of the continents.

The sea rises on the coasts and transgresses on the wide lands within, very gradually stealing over the lower levels. This process may not be steady and continuous. There may be periods of retreat followed by periods of advance, but always the land as a whole goes on sinking deeper and deeper into the sea. Many millions of square miles may be covered with the shallow seas.



Then at length there comes a resurrection. The land begins to emerge, but not the old land which went down. Where the great accumulations of sediment had been, mountain ranges arise. In short, what arises from the ocean grave is a crushed and wrinkled world, shattered by faults and over thrusts and exhibiting every evidence of great horizontal compression. One attendant of these events is the outbreak of volcanoes and floods of lava welling out of fissures in the earth's crust. The latter generally appear along western coasts, or to the west of the new born mountain ranges.




These events draw to a close when the land has attained its former elevation more or less. There is then a new era of geological history, a long era of organic process, lasting many millions of years, during which further evolution of the great and small life forms may occur. This is a period of active denudation. The last born mountains are degraded by denudation, and their sediments collected into the great troughs or basins, and the sublime but unrequiting sequence of events is repeated all over again.

Such has been in leisurely repetition the history of the earth. Certain world revolutions are generally a

cepted—although geologists are not all agreed as to their number—as comprised in the period of 150 or 170 million years while the statistics of inundation and the record of thoriaum lead us rise to the age of our era. Four or five world revolutions appear to enter into that time interval. Thus 50 or more millions of years may, tentatively, be ascribed to the genesis and consummation of a world-revolution.—*From an address by Prof J. Joly, F.R.S., before the Royal Dublin Society.*

The Relation of Suicide to Climatic and Other Factors

IN A recent number of the *American Journal of Hygiene*, Dr. J. R. Miner presents the results of an extensive statistical analysis of the relation of suicide to climatic and racial factors, and to industrialism, occupation, urban conditions, age, and sex. It has long been recognized that the suicide rate is higher among the Nordic race than among Alpine or Mediterranean peoples. Mixed peoples usually have a higher rate than either of the pure races to which they belong. Foreign



while in India it is low (48 per 100,000). India appears to be the only country where female suicides exceed the male. The general trend of suicide rates has been upward during the last century but the higher rates tend to become stabilized. Germany, France, Denmark and Sweden have high rates. Britain, Norway and the Netherlands low rates. In the United States the rates are lowest in the south and highest in the west.

Our Point of View

Radio in the Frozen North

RADIO, among other accomplishments, has robbed pre-war-day arctic exploration of much of its former terror. It has done away with the dreaded isolation that formerly went with such a venture. Men no longer pass out of touch with us once they leave behind them the northern outposts of civilization, for while they may be enquired by the icy wastes of the arctic wilderness, the long arm of radio reaches out to give them courage and cheer.

Last March a dinner was in progress in honor of Dr. Donald H. MacMillan, the famous arctic explorer. Several naval officers were present. Dr. MacMillan, in the course of a little dinner talk, made the following significant statement:

"You naval men and yachtsmen have not the slightest idea of what the real hardship of the North is. It is not the lack of food, because I have proven that we can live for three years or indefinitely, on the food of the Eskimo. It is not the cold, because we have proven that if we eat and dress as the Eskimo does, we can stand as much cold as he. It is the solitude—everything going out and nothing coming in. No one to talk to besides our own party of seven men except a few insignificant Eskimos, who grow very tiresome. Arctic explorers leave in the hope of something to shoot their own men because of insanity brought up by the solitude."

At this point Dr. MacMillan was asked why he did not take an efficient radio apparatus with him, and his answer was, "In any 8 ft foot boat space is so valuable that we could not afford to give up the room necessary." Yet on his past expeditions he took a small radio set requiring very little room, which radio set proved ineffective. No Dr. MacMillan was asked, "Well, doctor, fully 60 per cent of your space in the hold of your ship is given to food which you tell us you can do without. Why not give up some of that space to overcome the real hardship of the North?" His answer was to the effect that he had never looked at the question from that angle. Subsequently, and in preparation for his present expedition, the explorer gave up not the space in his hold but two very valuable berths in the forward end of the forecastle of his schooner "Hewden," in a powerful transmitter so that he might keep in touch with civilization.

And so our intrepid arctic explorer of today is keeping in touch with us from the frozen North in the arctic wilderness. Dr. MacMillan's answer does not come back at frequent intervals, even though he is now from there for the winter at Refuge Harbor on the northwest coast of Greenland, within 11 degrees of the North Pole. When it was first announced that he was to take both radio receiving and sending apparatus into the arctic, many engineers and scientists said that he would never be able to penetrate the curtain of silence around him by radio messages. This has been disproved. When Dr. MacMillan first arrived inside the auroral band it was difficult to get message back because of the fact that he was on 24 hours daylight, but now that he has a period of darkness the messages are coming back with great regularity. The American Radio Relay League, composed of the amateurs of the United States and Canada, sent Mr. Donald H. MacMillan an expert radio operator, with the MacMillan expedition, and all the amateurs are standing by night in their endeavors to hear him in the North.

So much for the "going out" part of radio. But how about the "coming in" part? That is the feature which combats the worst terror of arctic exploration—solitude.

Simple enough. Our broadcasting stations take care of the arctic explorers. Last Wednesday evening at midnight, Central Standard Time, we talk to Dr. MacMillan from the South Edward Radio Hour broadcasting station, WJAZ, and give him not only a résumé of the week's news, but also the messages from his friends and relatives and from the friends and relatives

of his crew of seven men. And this takes place in the spoken word, please note, and not the awkward and error-prone code of the radio telegraph. Aside from this personal service, MacMillan and his men are enjoying radio programs to the utmost—music, talks, sporting events, and so on. Where is the solitude of the far North?

The Laborer and His Hire

IN THE series which has now come to carry the title "Psychic Adventures," the articles describing Mr. Bird's experiences with Messrs. Sloan, Powell and Howe placed emphasis upon the claim that these mediums do not profit financially from their mediumism. In advancing this claim, we were merely repeating what had been told by Mr. Bird, in London, by persons who were in a position to know the facts.

Since the appearance of the articles in question, we have heard from Mrs. McKensie, of the British College of Psychic Science. It is through Mrs. McKensie that financial arrangements with these and other mediums are made, and when she speaks, we may substitute, for the belief that she "ought to know" what she is talking about, the positive assurance that she does know. The facts, according to Mrs. McKensie, are not quite as simple as they had been made to appear by those eager to put the medium in the most favorable light possible.

Mr. Sloan, so long as he remained in Glasgow, literally received not a penny for his mediumship. When he came to London, however, employment was found for him at common labor, paying his salary, shillings per week—well above the prevailing scale for such work, and in addition, from College funds, one pound per week was laid aside for his private expenses.

Mr. Powell gives many talents to his friends, either with no charge or with the mere remuneration of his expenses. But when he comes to London, he leaves his business for a week at a time, and it is at once proper and necessary that he receive compensation for this. Mrs. McKensie does not speak in pounds and shillings here, but she characterizes the fee which Mr. Powell receives for his monthly appearance at the College as "handsome."

Mr. Howe has calculated what he could earn as the caretaker of a house in the city, and the photographic medium, and has fixed a charge accordingly. But this charge applies only to those who go to him at Croy, and, even then, many sitters give him a ten shilling note or even a guinea, and that sum having no change. When he comes to London, the same situation exists, to less degree, as with Powell, and he gets enough to justify the trip.

The spiritualists who in argument slide over and even falsify these facts, do so with no realization that they are misrepresenting. They are firmly convinced of the genuineness of their mediumship, and they are, with the large spiritualist satisfaction which the source gives for a comparatively small return. Feeling so strongly that the medium gives more than he gets, they will not defend when the implication arises that he works for money. And they defend him not wisely, but too well.

Sloan while in London derived, Powell and Howe habitually derive, no small part of their livelihood from their mediumship. Our spiritualistic friends would do far better to face this fact than to seek to explain it away. For the medium devotes a very considerable part of his time to his mediumship, and in a day when money alone makes the man go, why should he not receive a fair remuneration for this work?

The justification of a medium on the mere ground that he accepts free, the implication that he should serve without pay, has always impressed us as the height of hypocrisy. Of course to the blatant fraud who swindles widows out of their insurance money through "mediumship" from their deceased husbands these remarks do not apply. We speak only of the medium who gives ordinary seances at a fixed or sliding

fee and gets no oblique return from his mediumship.

For after all, even a medium must live. Nobody has ever suggested that a medium ought to have a job, as the seer, as carpenter or bank driver, earning his living from this and giving such time as he can spare from it to the gratuitous healing of diseases. Nobody has ever argued that the priest or the medical doctor ought to be willing to support himself, marrying and burying people and healing spiritual ills gratis, between times at the wringer. The medium, to the people he serves, gives just as real a service as does a doctor or the parson to his constituents. Why ask him to give it for nothing?

United Atlantic and Pacific Fleets in One

THE American Legion, in Annual Convention in 1922, adopted, unanimously the following resolution: "We believe that all combatant first-line vessels should be concentrated in one fleet for purposes of better training and more economical administration, further, that this fleet should be based where it can be maintained and administered at the least cost to our government."

Our late President assured us that the Federal Government will have to practice economy for many years to come. This is true of every department of the government, and in the administration of the navy no less. Some millions of our revenue, it should practice rigid economy and stop only at the point where further reduction of expense would interfere with efficiency.

Now, one question in which a large reduction in expenditure could be secured, is to renounce our present divided, first-line battle fleet. For nearly twenty years before the World War, our first-line battlehips were concentrated in a single fleet, based in the Atlantic, but in 1920, apparently for political reasons, Secretary Daniels split the fleet in half, placing part in the Pacific and part in the Atlantic. The moving of the more powerful half of our battle fleet into the Pacific, together with Mr. Daniels program for building sixteen battlehips, produced considerable anxiety in Japan and a counter-building program was started in that country. Happily, we have agreed to a 5-5 ratio as regards Japan, with no development of naval bases west of Hawaii, and have signed the Five-Power Treaty for the settlement of any future differences between the Pacific powers that ocean, our Secretary of State has assured us that there is now not a cloud in the horizon.

There was never any sound military reason for splitting up our battle fleet, and it is not in the least against it. Our ablest strategist, Admiral Mahan, long ago warned the American people against dividing our fleet between the Pacific and Atlantic. He attributed the overwhelming of the Russian fleet by the Japanese largely to the fact that it was divided and each fleet defeated in detail. "It is precisely the same," he wrote, "as splitting a well-trained army into two halves." The Atlantic and Pacific coasts of the United States. Concentration protects both coasts, division exposes both."

Concentration means for efficiency. The larger the fleet, the better training it affords both for officers and men, and the maneuvers are more realistic and stimulate more exactly those that would be required in battle. The larger the fleet, the more is the training essential. How futile it would be if the Harvard football team should train its line in Cambridge and its back field in Pasadena, and then bring them together on the day of an important game!

Concentration of the fleet, furthermore, would result in marked economy. Our railroads and corporations maintain idle facilities overhead and reduce expense; our battle fleet must do it in some way or other. With the fleets united, fewer admirals with their numerous staffs would be required. There are hospital ships, supply ships, tug, etc., serving the battle fleet in the Pacific, and identical vessels elsewhere. The battle fleet in the Atlantic. Concentration will eliminate many of these auxiliaries, and make a marked reduc-

Our Point of View

tion in the number of officers and men then required.

But where shall the United single fleet be based? Now that the so-called "single fleet" sentence has vanished, there is every reason why the fleet should be based in the Atlantic. Let us consider some of these reasons. In the first place, there are eighteen states bordering the Atlantic, while only three, California, Oregon, and Washington, border the Pacific, and those Atlantic states provided in 1820 for the upkeep of the Navy eleven times as much revenue as those on the Pacific seaboard. More than three-quarters of all our states and 92 per cent of the population of the country have a natural outlet on the Atlantic, and they provide 94 per cent of the money spent by the Navy. Being half of our fleet in the Pacific, so far away from the center of population, brings added expense and waste of time in transporting officers and their wives and families out to the Pacific and then back again at the end of their tour of duty. Several naval transports are now engaged in this work.

Since the industrial centers of the United States are in the east, it follows that most of the ammunition, stores, equipment, etc., are manufactured in the east, and half of those, if the fleet is moved, must make the long and costly transit by sea to the Pacific coast, thereby adding greatly to the expense.

Last, but by no means least important consideration in favor of a single fleet, is the fact that the Atlantic seaboard has had many millions spent on it to develop Navy yards and harbors for the outfitting of the fleet. Today there are all operations at reduced efficiency, with high overhead expense, because most of the work for which they were designed is now being diverted to the West Coast, where plans are now being spent millions more of the public's money in developing bases, which can just as well wait until there is more money in the Treasury for such purposes. This is no time to spend millions in building up new Navy yards, when there are ample facilities for handling the whole fleet in the Atlantic.

Hudson River Bridge and the War Department

THE PROTECTION of our rivers and harbors against private encroachment is one of the important duties of the War Department. Before any canal can be thrown across a navigable river or any other kind of waterway, it must receive the sanction of the Army Engineers. It was because of these conditions that a public hearing was held recently in New York City, New York, for the purpose of hearing the arguments for and against the great bridge, which is proposed across the Hudson River, at or near New York City. It is a great pity for the future of this great enterprise that the meeting was crowded, and that some forty letters in approval of the bridge had been received as against three or four against it.

The principal objection, as voiced at the meeting, came from an unexpected quarter and certainly in an unusual form. We refer to the fact that one of the leading trans-Atlantic steamship companies, that, although the bridge was located as far up the river as Fifty-ninth Street, it was yet so far down the river that it might prove to be an obstruction to the maneuvering of the larger ships when they are entering or leaving their ports. It seems that the masts of some of these vessels extend 200 feet into the air, or 50 feet higher than the bottom of the proposed bridge.

To those of us who are familiar with the Hudson River, the location of the piers of the great steamship companies, and the manner in which the largest ships are maneuvered, it will seem rather absurd to claim that a bridge which is one-third of a mile distant from the piers could interfere with the passing of the ships. A capable captain, in making the pier, does not over-look the masts by twice the length of his own ship, and if he should do so he would prove himself to be incompetent and a candidate for suspension or dismissal. The steamship companies have been generously treated by

the city, which now asks that, in return, they shall do nothing to obstruct a great project which aims at the solution of one of the most pressing transportation problems of the city and the Metropolitan District.

The Industrial Fellowship System

WHEN future historians tell the story of the industrial development of the twentieth century, it will have a just sense of proportion that they will lay due emphasis upon the increasing cooperation between industry and science which has been such an outstanding fact of the past two decades. Our readers will remember the illuminating articles contributed by the late Dr. Robert Kennedy Duncanson upon the Industrial Fellowship System of which he was the originator. This was placed in experimental operation primarily at the University of Kansas in 1907, and it was inaugurated at the University of Pittsburgh in 1911. Two years later, the present Secretary of the Treasury and his brother established the Mellon Institute of Industrial Research on a permanent basis, and their continued financial support has made it possible to bring the system up to its present strong position.

What is the Industrial Fellowship System? Its aim is to promote industrial success through scientific research, that is to say, to find new materials and new processes for industrial development, and to advance manufacturing through the application of scientific methods to industry. The methods of operation are as follows: an individual industrialist, a company, or an association of manufacturers, having a suitable problem, or several of them, requiring investigation, may become the donor of an Industrial Fellowship, provided that the problem or problems are of sufficient scope to warrant the services of at least one man for a period of at least one year, and provided, also, that there is no other industrialization in process in the Institute on the topic suggested by the prospective donor. Thanks to the generosity of Secretary Mellon, the Institute is entirely independent and derives no financial profit from the investigations which it undertakes. Therefore, it is in no sense of a commercial nature. Furthermore, the executive staff of the Fellowship derives itself to the interests of the Institute (which, by the way, is a part of the University of Pittsburgh), without outside remuneration.

It should be explained here that the donor provides a foundation sum sufficient to cover the salaries of the Fellowship including operative charges, purchases of all necessary apparatus, and pays the salary of the research man or men selected to work on the particular problem. The Institute, in its part selects the Industrial Fellow for the particular investigation which is entrusted to him and to this he devotes his entire time. Also, it furnishes the necessary library and cooperative facilities, but all results obtained by the Industrial Fellowship belong exclusively to the donor.

Although the results of the investigation are confidential, many of the valuable data obtained are, by the courtesy of the donor, available for publicity and, as our readers are aware, no small part of this material has appeared from time to time in the *SCIENTIFIC AMERICAN*.

High-Speed Electric Traction

AT A recent time, under the heading "How fast shall we travel," it was shown that from fifty to sixty miles an hour is the maximum schedule speed on the best appointed roads here and in Europe. The limiting factor is the length and weight of the trains which are necessary to meet the ever increasing demands of passenger travel. It will be possible to make a considerable increase in the speed of express trains only by reducing their size and passenger capacity. To haul a steam train of twelve to fourteen heavy cars at an average speed of from sixty to seventy miles an hour would call for a constant expenditure of engine beyond the capacity of our existing tracks, bridges and tunnel clearances.

If the speed of future railroad travel is to be materially increased, it can be done only by the adoption of electric traction and the use of multiphase traction. The multiphase traction is a type of electric traction in the total horsepower without exceeding the loading limit for rails, bridges and structures.

The fastest speed ever attained on a railroad was achieved some 20 years ago in Germany, on a military railroad between Berlin and Zossen, where some costly experiments were carried on to ascertain how high a speed could be obtained on steam rails under electric traction, and at what expenditure of power. The experimental runs were progressive. The speed soon passed the 100 miles per hour mark, and then rose, successively, to 110, 120 and finally to 130 miles per hour. The limiting conditions were found to be not in the car but in the track, which proved to be unable to stand up under the severe stresses imposed upon it, and in the split of the fact that it was specially prepared for those trials.

We are thus brought to the conclusion that schedule speeds of 150 miles an hour can be attained only where the topography is favorable to fairly level and straight lines. Even under these conditions it would be necessary to design a specially rugged and track of costly construction, involving many tunnels, long and costly viaducts, the elevation or depression of the tracks through all towns and cities, and the complete elimination of grade crossings. The track would have to be equipped with some form of automatic train control, simple, rugged, and absolutely reliable.

But when, if ever, such a project built its cost both for construction and maintenance would be so great that its use would be restricted to those whose purse was deep or vain, by reason of emergency, were willing to pay a premium for an extra forty to fifty miles per hour of speed?

Thoughts on the Threatened Timber famine

WHEN we consider the possibility of a timber famine has brought to this office a thoughtful letter from Mr. James L. Wood, in which he suggests that in considering the world's diminishing supplies, a distinction should be made between coniferous woods and hardwoods, and directs attention to the vast area of hardwood in the tropics which has just hardly been touched. When the world's supply of hardwoods comes so much a fact to raise the prices of lumber, it will be more profitable, he believes, to take out many of these tropical hardwoods than to take out the comparatively slow growing hardwoods in our more northerly climate.

Then the question is asked, whether it would not be wise to consider reforestation under the two separate heads of protecting our wild lands and of carrying on forestry as a paying proposition. The Weeks law and other similar statutes afford protection to watersheds and natural parks, but, according to our correspondent, "it yet remains to be demonstrated what policy will best prevent a timber famine," and the work of the Forestry Products Laboratory at Madison, Wis., of which we have been described in the *SCIENTIFIC AMERICAN*, is referred to as giving the country much valuable assistance in forest conservation. The greatest enemy of our forests, the one that does far more damage than the axe of the lumber man, is the annual forest fire. The government is doing much to combat the fire menace. Congress should furnish it with funds to do much more.

In his plan for putting the question of timber preservation on a strict business basis, our correspondent asks whether it would not be false economy to plant vast lands simply because they are waste. It should be done only when it is certain that such lands would yield a profit in return, and the suggestion is made, that because of the more rapid growth of timber in the southern than in the northern states, it might be more profitable to do our planting in the southern states, even though the freight rates remain high.

Another Mediumistic Failure

Our Committee Sees "Independent Writing" Produced by Substitution of Cards

By J. Malcolm Bird, Secretary to the Committee of Judges



1111.30 Mr Arthur Conan Doyle was touring this country last summer, he met a medium reading in one of our mid-western cities. He had no opportunity for a sitting with her, but she showed him a large quantity of affidavits which had been given her by persons who had sat and been convinced that she was genuine. This she showed him as documents were such as to impress him strongly, and he brought her mediumship to our attention. We communicated with her and she agreed to come to New York and sit for our Committee.

The oracular material on these pages will have caught the reader's eye and informed him that he is to be told the story of an attempt to produce psychic phenomena through fraud. But as we have often emphasized, we are investigating, not mediating, but phenomena. The identity of an unsuccessful medium—even of a fraudulent one—is therefore to pertinent part of our story, and we shall withhold this lady's name, as we withhold that of our medium of last May. For present purposes she shall be Mrs. Y.

Partly through correspondence and partly through personal interview after the medium's arrival in New York, we learned the general character and the procedure of her manifestations. Their classification would be independent writing. The messages are produced upon pieces of card or paper, through the agency of instrumentality of flowers, leaves, etc.

The flowers used must be of colors recognized by the medium as "her." She breaks off a quantity of petals and leaves. For the reception of the mysterious writings she habitually employs index cards of fairly heavy stock, about five by three inches. At a single attack she handles anywhere from a dozen to a hundred or more of these.

The first step is to place the fragments of the flowers among the cards. No attempt is made to put petals or leaves between every two cards, they are merely placed in considerable quantity here and there through the pile. When this has been done, the cards, of course, are rather wabbling, and cannot be stacked accurately. Mrs. Y takes the pile loosely in her right hand, and the usual procedure is to hold it over the head of some member of the group who she recognizes as her "opposite." She characterizes herself as magnetic, and requires that the "battery," as she calls the collaborator, shall be "electric." She gravitates toward males in preference to females and toward dark complexions rather than light. After holding the cards upon the "battery" head for no inordinate period, it is found, to quote her own explanation, that "the coloring matter of the flowers has been precipitated by the psychic operators to form written messages upon the cards." These messages are not, as one might infer from their mode of production done in wide sloppy lines. The effect is entirely that of actual penmanship in colored ink. The medium does not profess to understand the details of the process, all she claims to know is the procedure, and the fact that the messages appear.

In any attempt at independent writing the identity of the penmanship is always a great interest. Mrs. Y, in response to question, explained that she has a spirit guide named Rife. Rife, if I may borrow from one of the local reporters, is "an atmosphere of the beyond." She has her own characteristic penmanship, and the messages are often in it. Sometimes, however, the signature is different, and may or may not be

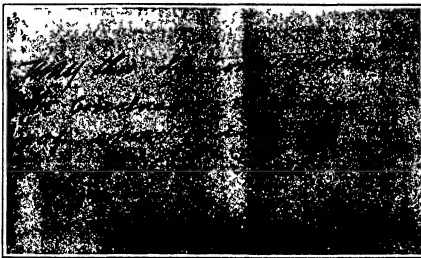
establishable as that of the alleged communicator. Mrs. Y, therefore, represents Rife as actually writing to the communicant's dictation, and as sometimes signing the name herself, sometimes leaving that to him. Sometimes, however, we were told, the entire message is in a penmanship which is presumed to be that of the communicant, sometimes it is distinctly recognizable as the handwriting of the writer, and other alternatives occur occasionally. Direct personal messages from Rife are often

encountered claims recently approaching Mrs. T. A. I shall, therefore, refrain from taking up any of the collateral aspects of the sitting, just how we know that the writings produced in our presence were not genuine.

The first sitting was held in the SCIENTIFIC AMERICAN editorial rooms on October 31st. We had procured the necessary cards from a local stationer, a package of 40 of them had been counted out and was turned over to the medium at the beginning of the sance, the trial, with one "battery" or another, for about an hour, and finally concluded failure, expressing confidence of better results next time. It was not at all a determined effort, nor one that Mrs. Y would have had to exert herself to defeat. She did defeat it, retaining the fragments to the end of the sitting, when she handed them to another sitter for destruction. After the medium had gone, the room was thoroughly searched and all fragments of the cards recovered. None of them had been torn into small pieces, and it was possible to patch them all together. When this had been done we had only 40 cards. Our impressions during the sance had been that if, under the given conditions, the writing described to us was to be produced by *frank*, the fraud would necessarily involve the substitution of previously prepared cards. With our flowers, our cards, and our conditions, we were not inclined to believe that the writing could be actually manufactured, *frankly*, in our presence. The disappearance of five cards seemed to confirm this view. But we could have no idea whether our own cards were to be substituted back, or whether they were to be used as samples from which other cards would be obtained for this purpose. The former procedure would be the safer, but would be open to the objection that the number of writings which could be produced under it would be limited.

For the second sitting, held in our office on Thursday the 11th, we had to meet both these possibilities. The medium, on turning over to me the cards, explained that she had, during the sance, had requested that these identical cards be employed on Thursday, since they would probably have a lot of magnetism left in them "from her handling." After I had rejected a few badly marked ones, there remained 33 cards. These were marked by tiny pin pricks in one corner of each card, and all the cards placed with their marked sides down. The lady, however, whether by accident or by design, a good psychologist, turned the package over in placing it upon her little work table. She sat down at this table and, under pretense of looking for dirty cards, examined the pack. The first four or five cards she scrutinized with an extreme of care quite incompatible with this explanation. On looking up at all the cards as if a person who had found what she sought, she went through the rest more rapidly, rejecting one or two which were no dirtier than the others. I had no doubt that she had found the pin marks, and the other investigators agreed with me.

While thus examining the cards, Mrs. Y asked me whether the cards used on Tuesday had been counted. It was with difficulty that I refrained from smiling as I told her yes. She expressed gratification at our thoroughness, and I was highly gratified at hers. During this sitting she again tore up cards, but this time she



This "spirit message," from a man whom at the moment the sitters supposed to be living, is in a brilliant gold pigment, which under microscopic examination shows actual metallic crystals.

obtained, presumably always in suitable chirography. The Editors and Committees in advance, and several attenders during the sance, asked the medium where, in the pile of cards, the writings usually came. On this point she contradicted herself repeatedly. Now she would tell us that the writings appeared only upon cards adjoining flowers, now that they would come on the three or four bottom or top cards, and several times when the cards were examined for possible writings



This distinguished communicant, on the other hand, writes in a reddish ink mark which, under extremely high magnification, shows no grain or other structure. Stray crystals of gold here and there indicate that this card was written with the same brush as the one pictured above.

she insisted that the searcher look at every card. These contradictions were not a great trouble from day to day that the attention of the most sympathetic sitters was drawn to them.

If the phenomena just described occurred frequently, it would, of course, be one of the most extraordinary of all psychic manifestations. Indeed, it would probably be quite unique, none of our investigators had ever before

Our Abrams Investigation—III

Comments on Our First Test and a Look Ahead to Other Tests and Studies

By Austin C. Leacourbour

Managing Editor, SCIENTIFIC AMERICAN, Secretary to the SCIENTIFIC AMERICAN Abrams Investigation Committee

IT WAS to be expected, we have heard from all parts of the country regarding the report of our first test of the electronic reactions diagnostic which appeared in our November issue. The comments represent three distinct shades of opinion. First, there are the orthodox medical men, quite naturally, are pleased with the negative results, secondly, there are the electronic practitioners who are obviously displeased with our findings, and who have just ready to offer reasons for the negative results, thirdly, there are the laymen who, in the capacity of final arbiters in this matter, are glad that our investigation is under way.

It would be quite impossible to quote the various comments which have been received, but it is our intention here to present in digested form the various shades of opinion and comment which have been presented.

When we first entered this Abrams electronic controversy, it was our original and superficial opinion that the subject matter could be readily settled with. The claims, fantastic as they might seem in the light of orthodox medicine, could readily be checked up so that a favorable or unfavorable verdict would be arrived at in short order. It also appeared to us that we were dealing with but one definite method of diagnosis and treatment, namely, the electronic reactions of Abrams—known as R. E. A., for short. This, of course, would make the matter relatively simple. Instead, and much to our surprise, things immediately proved that there are many variations of the electronic reactions diagnosis and treatment. Abrams stands out as the originator of this entire technique, but there are many departures from his teachings. Here and there we find entirely different methods, and some of these are the electronic reactions, so that it becomes necessary to differentiate between the two Abrams electronic reactions and those of other brands.

And so we hasten to reiterate at this time that the equipment and the methods employed by Dr. X, who cooperated with us in our first test of the electronic reactions diagnosis, are not those employed and recommended by Dr. Abrams. The air-drum method of perceiving, which is described at length in the report, is no longer employed by the Abrams practitioners who have better methods, so they claim, of detecting the electronic reactions of the human reagent. The equipment used for our first test was not manufactured by laboratories controlled by Dr. Abrams, although, truth to tell, the equipment in question struck our critical eye as being of better workmanship, so far as external appearance than Abrams apparatus which we have seen elsewhere.

Now, then, we are confronted by a curious situation. We must make certain in every test that we are dealing with genuine Abrams equipment and technique, or with some other equipment and technique. Dr. Abrams himself has warned us not to confound his methods with those of others, and to bear in mind that there are over forty "bogus" electronic reactions devices on the market.

To differentiate between the genuine Abrams article and others is not a difficult matter. But our obstacle takes the form of giving the electronic reactions diagnosis an unbiased and thorough test. If we are to listen to Dr. Abrams, the only way to do this is to be told in no uncertain terms that Dr. Abrams himself, and no one else, should receive all our attention. We are very enthusiastic and anxious to cooperate with the leading exponents of Dr. R. E. A., although we are entirely at liberty to get their views and comments regarding the subject matter, and to simply conduct our investigation, our committee is invited to visit Dr. Abrams at his clinic and laboratories in San Francisco.

A visit to Dr. Abrams, and a study of his technique should form an important part of our investigation, it goes without saying. However, our tests must also deal with reactions which are not those of Dr. Abrams, because the obvious one is that the average individual never deals with the originator of this technique but with one of his local representatives. That is

the important point. We mean to test the R. E. A. under real, practical, everyday conditions, so as to have a workable decision with regard to the entire question, rather than a theoretical, unimpaired, and, as to speak plainly, "ranged" investigation which would leave the fully qualified practitioner with a question.

We have received from Dr. Abrams a list of recognized R. E. A. practitioners who have ready reach of our investigating committee, and we shall make every effort to secure their cooperation. Our work already, several of them have shown the kindest interest in our work and a willingness to aid in every way. At this writing we are arranging for a test in which a number of recognized Abrams practitioners will take part. A collection of pure gum culture, prepared according to their instructions but quite without their knowledge, will be diagnosed by these practitioners and their various findings checked with the results of the culture. This demonstration will be most interesting. We hope to have the report for our January issue.

Another test will be made with the R. E. A. practitioners. But now we come to the real complication. It seems that the electronic reactions technique is far from a perfected thing and that much still has to be learned indeed, almost weekly some new "rate" is discovered and some short-cut or better way of diagnosing and treating is developed. By an R. E. A. practitioner to the prevailing opinion, Dr. Abrams is by no means responsible for all this technique, for much of it is being followed by him. In fact, the feeling among R. E. A. workers adheres closely to the Abrams technique, but

discoveries and possibilities of Dr. Abrams then Abrams himself. Indeed, we have been said to devote the better part of our tests to the improved methods which, we are told, will give us answers where Abrams himself would perhaps fail.

Much the same may be said of the equipment employed. We have received numerous pieces of literature put out by manufacturers of electronic equipment, the writers of which have displayed real art in inspiring the reader's confidence in the electronic reactions on the one hand, and then, by multiple argument, swinging over the reader to some particular kind of apparatus which gives results when the others fail completely. We were somewhat thrilled when we received what appeared to be a real, scientific, and thoroughly comprehensive report on electronic diagnosis and treatment of disease, written by a consulting electrical engineer. The title page and the diagrams led us to believe that, at last, was a serious report on the subject which would throw considerable light on the intricacies of the electronic technique, by giving us the salient facts in simple English. Much to our disappointment, however, the report goes on to tell us that there is something in the technique of the electronic reactions, but the existing apparatus is crude and unreliable, and that there is better apparatus now available which will give positive results. Subsequently, by another mail, we receive a bulletin announcing NEW apparatus for electronic diagnosis and treatment, in which all the former drawbacks and imperfections of the old apparatus have been improved. We have been made. Needless to say, this bulletin comes from the same source as the report above.

Hence we shall have to devote our attention not only to Dr. Abrams and his R. E. A., but to the other electronic workers who claim to have something better than the original technique. Furthermore, we shall have to make certain that we are dealing with the same apparatus in our investigation. Merely to scratch the surface of the Abrams question soon discloses that there is little love lost between the various electronic practitioners, and that their references to one another are most uncompromising but at all times in perfect reciprocity.

Returning to the comments on our first test of the R. E. A. and other electronic practitioners seem agreed that Dr. X did not know what he was doing. "Why report findings of five or six other electronic workers who claim to have something better than the original technique. Furthermore, we shall have to make certain that we are dealing with the same apparatus in our investigation. Merely to scratch the surface of the Abrams question soon discloses that there is little love lost between the various electronic practitioners, and that their references to one another are most uncompromising but at all times in perfect reciprocity.

We have been seriously reproached for giving any attention whatever to Dr. X, since he is not a recognized R. E. A. worker. What we have already stated of the trapping action of the electronic reactions, we found it to exist, explaining why we must make tests wherever we believe we can learn something regarding electronic technique. Dr. X, who has been giving electronic treatments to a large clinic in New York City and has made his name as a practitioner, has been making revolutionary claims, was the first to come forward and extend his cooperation to our investigation committee.

We have been criticized for not mentioning Dr. X's name, but we believe that it is best, for many reasons, not to mention his name. First, we are not sure if our findings in any one test are adverse, it is best not to mention names. If our findings are favorable, similar to those which we have found in the R. E. A. investigating one device, or another, we are investigating electronic medicine as a whole. The doctors and R. E. A. workers are all working on the same line, and it is to cooperate with us so that we may present the true story of electronic medicine to our readers.

AN investigation of the electronic reactions of Abrams and other electronic methods of diagnosis and treatment has been undertaken by the SCIENTIFIC AMERICAN. A committee, composed of unbiased, keenly interested scientists will formulate the various tests to be undertaken as well as pass upon the results obtained. The investigation is based primarily on obtaining first-hand data as the result of our own tests and observation. We are investigating the electronic technique as a whole, and not the individual practitioner. We invite the cooperation of everyone, in order that the true facts may be presented to the public.

here and there an R. E. A. worker strikes out new lines. In fact, some R. E. A. practitioners are frank to say that they have used Abrams' original technique to become acquainted with the electronic reactions, and then have developed their own equipment and technique which, if we are to believe them, are far in advance of those of the originator.

Now the point is that these distinct variations from the Abrams technique cannot be ignored for a moment. While our investigation is termed an "Abrams" investigation, it now develops into an investigation of the electronic reactions proper, taking in all manner of equipment and technique which still bear some semblance to the R. E. A.

Some R. E. A. practitioners whom we have not have informed us with the fact that they, rather than Dr. Abrams, can give us a convincing demonstration of the merits of the electronic reactions. They have told us that Dr. Abrams has discovered a wonderful thing, but that he has not developed it to the full. Meanwhile, while they become acquainted with the fundamental truths and the original technique of Abrams, they have forged ahead with their own equipment and technique and have left Abrams some distance behind in electronic reactions practice. Some have boldly set up their own technique and have broken off entirely with Dr. Abrams, although they become acquainted with the fundamental truths and the original technique of Abrams, they have forged ahead with their own equipment and technique and have left Abrams some distance behind in electronic reactions practice. Some have boldly set up their own technique and have broken off entirely with Dr. Abrams, although they become acquainted with the fundamental truths and the original technique of Abrams, they have forged ahead with their own equipment and technique and have left Abrams some distance behind in electronic reactions practice.

Efforts have been made over and over again to keep us with the fact that these electronic reactions workers are far better exponents of the fundamental

SCIENTIFIC AMERICAN, December 1933

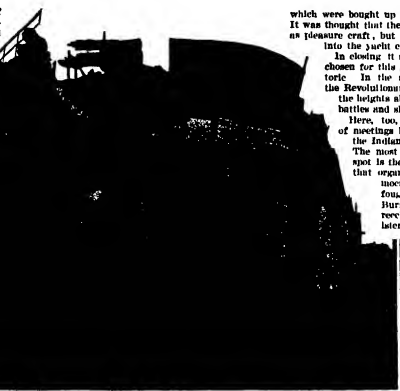
The Last Harbor of Forgotten Ships

Where Old-Time Clipper and Modern Submarine Chaser Meet for the Attention of the Salvager

A LONG a goodly stretch of the west bank of the Hudson River, just north of Weehawken, New Jersey, is to be found a typical graveyard—the last resting place of forgotten ships. Here, vessels that have done good service in their day and have fought their way through wind and weather for many a long year, have found a last resting place. It is a weird and miscellaneous gathering of derelicts, a veritable museum of types of all periods and of every manner of construction. If there is any future life for these vessels, it lies in the salvage which is taken out of them, for their iron is recast or reworked, to do service in many of the different arts; their timbers also are used for structural purposes, sometimes even to shelter man once more from the milder mischances of wind and weather upon the shore, while the richest of all treasures grows in the copper and brass which find their way into arts too numerous to mention.

Perhaps the most appealing among these works are the fine sailing vessels which stand there, gaunt and stiff, like fine old aristocrats of a former day, with their graceful prows lifting high above the water. With the coming of the war, these old sailing ships found a use, and from out of harbors here and there along the coast, came to do service as freight carriers. Their period of service, however, was short, and at the close of the war many that were not sold abroad found their way to the graveyard.

Many types are included among these old sailing ships. Among them are representatives of those beautiful vessels, the clippers of the fifties and sixties, probably the most perfect merchant craft that were ever propelled by sails. In their day, the best of them surpassed the steamships in speed. That was in the period when the United States stood in the forefront of the ocean-carrying trade. For many months, one of the most interesting of the derelicts was the "Granite State," which was brought over here from across the river, after being burned at her dock, to be broken up for the copper, brass, etc., that was in her. Subsequently, while being towed north for final breaking up, the "Granite State" caught fire again and went to the bottom. This representative of the old three-masted dandy of the time of sail power and the smooth-down, not far from her stands what was once the flagship of the New York Yacht Club, the "Electra." In her dismantled condition, she is hardly recognizable, and seems to be a symbol of the familiar tragedy which made her owners wish never to see her again. Then we notice the old floating dry docks, dating from Hannu only known how many decades ago. And of course the lighter, that indispensable element of harbor traffic, forms a conspicuous part of the assembled ships. Here also are to be found small barges, some of which came, from the job



Remains of the historic old "Granite State," ready for the salvager. The timbers in old ships such as this one find a variety of uses.

of them, date back almost to the opening of the Erie Canal. Farther along the shore we see the "Hatterus," its name recalling the gales of fifty years ago when she was the queen of river boats and her decks, as she went up and down the quiet waters of the Hudson, resounded with music and the shuffling steps of the dances popular in those days. Close by is another famous boat, the old excursion barge, the "Columbia," memorable in the minds of the sporting fraternity from the fact that here John L. Sullivan fought one of his famous battles.

Of course, the most striking group of vessels is the closely packed fleet of submarine chasers, sixty of

which were bought up after the war as a speculation. It was thought that there would be a demand for them as pleasure craft, but very few have found their way into the yacht club.

In closing it may be mentioned that the spot chosen for this graveyard of ships is little historic. In the adjacent country campaigns of the Revolutionary War were conducted, and on the heights above, placards tell the stories of battles and skirmishes.

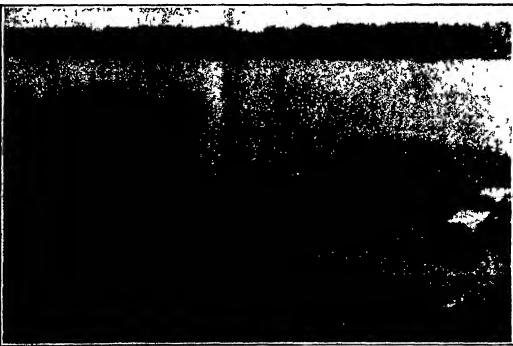
Here, too, there are thrilling memories of meetings between the white settlers and the Indians, and of deplorable massacres. The most melancholy association of this spot is the death of Alexander Hamilton, that organizing genius of our young democracy. On the cliffs above he fought a well-known duel with Aaron Burr and with his pistol in the air received the fatal bullet of that sinister character of our early history.

Copenhagen-Bornholm Wireless Telephone Service

THE island of Bornholm, which so far enjoyed no telephone or telegraph communication with the rest of Denmark, has just been connected with Copenhagen by a combination of radio and wired telephone system, subscribers at both ends communicating with one another without any special apparatus merely by calling up the exchange in the usual manner. While the transmission of weak telephone currents to the radio transmitting station and in a similar manner, the transfer of feeble received impulses to the telephone line at the receiving end entailed a suitable amplification by means of vacuum valves, special difficulties had to be overcome in insuring a duplex service, i.e., the possibility of simultaneous transmitting and receiving without any mutual interference and without any necessity for the subscriber to switch over from one service to the other. The proper distribution of the speaking and listening currents is effected by means of a "distributor" working on the Wheatstone bridge principle.

A new Lorenz-Poulsen transmitting station has been provided near Långby at the Copenhagen end, an isolated loop aerial on a 25-meter mast being used to receive the electric waves. The receiving plant is installed in the island of Amager to the southeast of the Danish capital. At the Bornholm end, another Lorenz-Poulsen transmitter has been installed at Hannevors. In the northern angle of the island the receiver being situated near Binn Harbor, on the western coast.

Successful radio telephone tests between the Copenhagen and Bornholm apparatus, on the one hand, and Berlin, on the other, were made previous to the opening of the new service, thus demonstrating its possibilities under conditions more exacting than the daily routine. Other tests were made between Copenhagen and the American steamer "United States," whose captain, while on the high sea, remained in permanent telephone communication with Copenhagen telephone subscribers, very much like our tests with the S. S. "American."



General view of a section of the ship graveyard, with a large boat of submarine chasers in the right foreground. The background is formed by the up-down section of Manhattan Island.



Left: The suction dredge "Cyprian," the property of the Toronto Harbor authorities but loaned to the contractors for the Queenston-Chippewa power project. Right: The dredge "Mara" showing a levee break north of Sacramento (1918)

Two famous dredges engaged in important work

Some Great Dredges

Monster Grab-Buckets that are Able to take Fifty Tons of Mud and Rock at a Single Bite

By J. F. Springer

ENAVIGATING apparatus has been greatly developed because of the demands made by general construction in the United States and Europe particularly such great works as the Rues Canal, the Chicago Drainage Canal and the Panama Canal. The steam shovel is largely responsible for the success at Panama in cutting through the dividing ridge separating the oceans. The dredge cut the canal in the fresh and salt water sections and built a great part of the Panama Canal. If a slide, big or little occurs, it is the dredge which is relied on to open up the great waterway again.

All over the country dredges are more or less in use. They float from point to point, and excavate soft and hard material. On the Panama Canal, though the big ditch has been completed for a number of years, active excavation is still going on. From the canal prism itself, some 3,511,819 cubic yards of earth and rock material were removed in the fiscal year ending June 30, 1928. All of this, in addition to auxiliary work, was done by six big dredges, three of them being of the dipper type and three of the pipeline suction class. The dipper dredges—the "Paraiso," "Gambou" and "Caendard"—are glass-bottomed dipper on each has a rated capacity of 15 cubic yards. It is big enough, when set with the opening up, to permit 34 men to stand, without undue crowding, upon a platform suspended inside the great opening. The "Paraiso" was one day engaged in its work, the great hull, from which the pneumatic arm and dipper are operated, floating quietly on the smooth water. The operator had no notice of anything unusual until he saw a stone appearing above the surface. It was a monster flint stone that was being brought up by the dipper. No shock or tremor seems to have been felt on the vessel when the dipper secured its great load. The stone must have weighed, even when totally submerged, around 50 tons. Upon emergence the weight naturally went up to the 80 tons. A mighty machine, indeed that can take in so quietly at the end of a long lever such a weight as 80 tons and that is not disturbed when this weight grows to 100 tons. It was thought rather unsafe to put the stone in one place on the attendant scow. In fact it was blasted three times while still on the dipper, and thus reduced to manageable sizes. In nine months in the fiscal year just mentioned, this same "Paraiso" excavated 947,260 cubic yards of material, over half of which was rock. The unit cost is estimated at having been

\$0.44100 per cubic yard. The slater dredges also did a great work, though at costs somewhat higher.

The pipeline dredges are also big fellows and competent to the performance of severe service. Some may wonder that so much work is going on at Panama. Part of the work consists of new construction and part is to be classed under "maintenance." As a matter of fact, the new construction amounts to only a small percentage of the whole. Upon July 1, 1920, there yet remained to be taken out of the prism of the canal the very considerable amount of 2,260,000 cubic yards of earth and rock. This material may be classed as alluvial material from slides, and original material. Really, the canal will never be done, even when there are no more slides and when all original material has been taken out and away. Gatun Lake, through which a very large part of the canal runs, is the recipient of waters belonging to the old Chagres River. The torrential streams thus made tributary to the lake bring down naturally their quotas of material from their several watersheds. However, it will probably be some time before the last slide becomes a matter of history. As long as there is any real reason to fear a considerable slide, the dredging capacity will have to be kept and the high-class dredges.

Dipper dredges operate much after the manner of the regulation steam shovel. There is a great boom

which furnishes a fulcrum for the operation of the arm at one of whose ends the bucket is attached. A rope, secured to the bucket and passed over a wheel at the end of the boom and thence carried back to a drum on board the vessel, provides the means of swinging the dipper-arm. The dipper is continually open on the side next the material to be secured. On the opposite side is a bottom hinged on the side next the arm. Ordinarily, the load, when secured, lies inside the bucket. It is dumped by releasing the hinged bottom, where the material drops onto the pile or scow. The action is entirely different from that of the pipeline suction dredge. In this case, the material is sucked in through an opening and then pumped on through a pipe line. By the use of relay pumps, the material, together with a quantity of water, may be conveyed long distances and to elevated positions. In the original construction of the Panama Canal, part at least of the material for Gatun Dam naturally had to be elevated. In certain comparatively recent work on the canal, the dredges were just about a mile distant from the outfall.

There are quite a number of varieties of dredges. On the Pacific Coast, for example, recent years have seen the introduction of a new type of clam-shell dredge. The clam-shell excavating bucket has been found very useful in deep excavation, and in the handling of coal.

It and the cross-pole bucket have also been found serviceable in wet excavation. The clam-shell bucket consists of two halves which open from and close upon each other much as do the valves of a clam. A good type of bucket will bite into the material being excavated and thus secure a good load. That is, they dig as well as shovel.

On the Sacramento River, certain big dredges, as the "Moptone" and "Mara," have been doing great service. Naturally, the vessel used is a considerable affair. It is provided with an A frame or an equivalent as a means of providing locations from which a great boom may be operated. This boom may have the enormous length of 240 feet, and the bucket operated from its outer end may have a capacity of 8 cubic yards. This is but little more than half the capacity of the three monster dipper buckets on the Panama Canal plants. On the other hand, a boom of 240 feet has a reach far beyond anything possible with the dipper dredges. In fact, the latter must discharge slowly, as in an attendant scow, while a boom can collect a clam-shell bucket may operate in a pretty wide waterway and still deliver material



Dipper dredges of eight cubic yards capacity at work in the Chicago Drainage Canal

secured ("spotted") to either bank. It is said that cable having a width on the bottom of 600 feet have been constructed by this type of device without requiring any rehandling of the spoil.

Ordinarily, the boom is set with its outer end at the desired level and is then not lifted nor lowered while the bucket goes and discharges its load. The boom is, however, swung in a horizontal plane, thus enabling the bucket to carry the material to the shore and to return to the excavating point.

An interesting feature of these great dredges is the enormous boom having length of 240 feet. Timber is used in the construction, and is in fact believed to be the only suitable material for the severe service calling for great elasticity. This size of boom is made up by using sections 110 feet long. The joint is made by scarfing the ends and then bolting them together. The length of such a joint is 27 feet. In order to control lateral bending, the booms are strengthened by means of a cable which passes through saddles arranged on the ends of cross-arm struts. There is a certain amount of slippage permitted and this gives a degree of flexibility. Numerous guys run from the A-frame to points along the length of the boom and at ends of the struts and thus add to the power of resistance to loads at the end of the boom. In fact, prior to the attachment of the bucket, the guys are so adjusted as to lift the far end a distance of 2 feet. This is to compensate more or less completely for the bending consequent upon the weight of the bucket and its load.

An interesting feature concerns the method of compensating for the dip of the boom consequent on the lift of the vessel when the boom with its load is swung. It has been found that the overturning of the A-frame has a tendency to elevate the boom when it is swung. As this is a tendency the opposite of that produced by the lift it may be utilized for the desired purpose. It is, however, necessary to adjust the overturning to just the right amount to produce the best result. It is understood that it is possible so to put the one thing to nullify the other with such particular dredges as to make it practicable to swing the loaded boom end in a substantially horizontal plane. The operation of the booms is controlled by the use of two cables running through sheaves at the ends of the boom. When the earlier designs were in use, the high winds which often prevail over the lower section of the river made it difficult or next to impossible to swing the dredge during their continuation. But now, a recent improvement has been adopted, which consists of providing water ballast tanks along both sides of the boom. These tanks can be operated in such manner in conjunction with the overturning as to offset an atmospheric wind and thus permit the boom to be worked almost as usual.

Another advance in design is one that concerns the



13-yard dipper dredge "Gambosa" at work on Cucaracha Slide, Panama Canal

operation of the two control cables. A great variation in the positions of the cables is required in order to control the boom in widely different locations. A pair of sheaves was, in the earlier dredges, attached to each of the two sides of the A-frame down near the base. These sheaves, known as "sister sheaves," were to provide sheave action whenever possible. It was found, however, that one or more times during every cycle of operation, the cable would cut across the flange of a sheave and suffer abrasion in consequence. The improvement in design consists in the use of a single counterbalanced sheave which is so designed that it automatically adjusts itself to any and all positions without inducing more than one bend in the cable. This change has resulted, it is understood, in a considerable prolongation of the life of the cables.

An idea of the size of these dredges may be got by a consideration of some principal figures. The "Neptune," for example, is about 150 feet long and 70 wide. The depth is 18 feet. The top of the A-frame rises about 82 feet above the deck. At the apex of the A is attached the tugging cable—that is, the cable which lifts the boom. It is rigid in 10 feet and consists of a galvanized steel rope $\frac{1}{2}$ inches in diameter. It is estimated that the stress on this cable when the bucket is loaded is about 110 tons. The bucket itself weighs 15 tons and the load about 12 tons. The boom is a heavy affair weighing around 12 tons. The cable acts at a disadvantage because its angle of elevation above the horizontal is necessarily a flat one, and this is the reason why a weight of 27 tons plus some additional force from the hoist is able to produce a stress of 110 tons. Certain "log rods," $\frac{3}{4}$ inches in diameter, have the duty of holding the A-frame. It is said that these rods endure, at the time of a full load, by swinging the maximum distance on one side, a stress of 145 to 180 tons. The legs of the A-frame are likewise put under severe compressive stresses at the same time.

That there must be lacking faulting in the rigidity of the construction will perhaps be glimpsed when it is borne in mind that such dredges as the "Neptune" and the "Mam" are operated 24 hours per day and that a

cycle of operations is gone through with in from 105 to 120 seconds. The big dipper dredges at Panama are able to go through a cycle in much less time, when a great struggle was going on to beat the slides, they were put upon a cycle of 45 seconds.

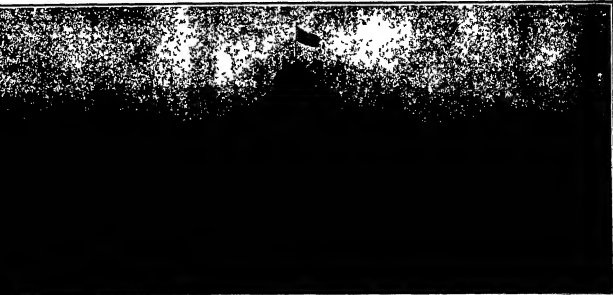
The Lifting Lock

There is more than one interesting variant upon the ordinary canal lock. Along the line of the Old Morris and Essex Canal, for instance, which climbs the Jersey hills at numerous points, may still be seen the results of the "canal railways" by means of which these climbs were effected. These are nothing more or

less than inclined planes, separating the two levels of the waterway, upon which the boats were hauled bodily on a wheeled carriage at the end of a cable. Another, and more advanced, expedient, is the one which we illustrate herewith. The photograph is taken at Peterborough, Canada, but similar installations are found here and there throughout the world, and we have a dim recollection of having derived one of them before. In the case of Peterborough, the stream is a part of the Trent water-power development, and, at the same time it is desired to have the way navigable for barges of moderate size. There is a material descent at Peterborough, one of the points of actual power development. Instead of the ordinary lock, the hydraulic lift is employed. This consists, in effect, of a big stator, sufficiently large to accommodate any vessel which the stream itself would accommodate. If the barge is to be in the downward direction, the lift is raised to the upper level, in which position it is adjacent to the regular waterway on this level, and like an ordinary lock, constitutes in effect a continuation of this. The gate between the river and the lift is opened, and water flows in to fill the lift, after which the vessel is admitted and the gate closed. The lift is then lowered to the lower level, where the gate at the other end is opened and the vessel goes its way.

When the lift is being raised, empty, the right hand gate of our picture is allowed to remain open so that the load of water does not have to be raised too. When it is being lowered empty the water is allowed to remain in it to aid the lowering with its weight. The system is particularly adapted for use on a power waterway, since it uses less water than the ordinary lock which has to be filled to its entire depth corresponding to the difference in elevation between the two levels, and the water used for this purpose, in a downward lockage, comes from the power flume.

The Peterborough installation is believed to be the highest of the kind in the world. The lift which we illustrate seems to scale about 60 feet in height when measured against the men standing on the upper level. It raises or lowers a vessel in twenty minutes.



The Peterborough (Canada) lift-lock, combining the features of a lock and an elevator

Driving the Bomber to High Altitudes Latest Guns Make the Air Deadly at 20,000 Feet, and Dangerous at 30,000 Feet

A MATTER stand today no matter how excellent may be the new guns and the military strategy developed in the Army and Navy, the question of whether the pilot can sink and how soon is decided by the improved weapons now in use.

It is these improved weapons that have built in numbers the navy for their constitution must be appropriate; and the military machine are determined; it is a fact that is not and does not profess to be scientifically trained. Although this is a wise constitutional provision it has the serious defect that due to lack of knowledge or to misfortune in a crisis is liable to withhold him to whom they are urgently needed or to grant them for experimental devices which subsequently prove to be useless.

These conditions are always felt as they are particularly so in regard to the military. The public is always attracted to the spectacular and unfortunately the experimental building of battleships as carried out two years ago, and this year off the Virginia coast when several anti-aircraft battleships and cruisers were sunk by machine guns in the minds of those who undertake to write about Navy and military matters that they have proclaimed the battleship as already dead, and the airplane as supreme. Why build a battleship costing \$40,000,000 when an airplane costing the mere fraction of that can sink it with a single bomb?

There are two major fallacies in talk of this kind. First the ignoring of the fact that the battleship atacked were not built; the second that they were provided with no means of defense whatsoever. The death of these battleships was an certainty as is the death of an or when it is struck by the pole of the lightning.

Much has been made of the fact that a vast amount of anti-aircraft ammunition was expended in the world war to very little effect. But the anti-aircraft guns of 1914 to 1918 were feeble weapons compared with the anti-aircraft artillery which has been developed since the armistice. During the war were accustomed to fly over hostile territory at low elevation with comparative immunity. For the reason that the range of the anti-aircraft artillery and its rapidity and accuracy of fire were limited. Today the low wartime range of flight we could be literally covered with machine gun bullets and with a barrage of bursting shells. Moreover, what is true of the land fighting of the future is true also of fighting upon the sea. The battleship will battle with machine guns with a maximum vertical range of 12,000 feet and with automatic gun firing 14 inch high explosive shells with a maximum range of 14,000 feet. Two new guns have been developed by the army which are effective at 20,000 feet and 47 inch guns with a vertical range of 30,000 feet. Furthermore it must be remembered that the shells fired in these weapons are much more than ammunition. They are a trail of smoke behind them and are capable of being brought to bear directly upon enemy airplanes at ranges of 7,000 feet, 14,000 feet and 21,000 feet. Now if in the leading experiments off the Virginia coast effective shells could be made up at elevations of from 3,000 to 7,000 feet and the only because there was no interference with the highest battleships below what kind

of shooting would have the air born close gun bullets shells and sharp elevations of from



Our 30 inch anti-aircraft gun, Model 1920, in the firing position

10,000 feet? We doubt if a hit would have been made. Gunner reader whenever a so-called naval or expert military writer tells you that the battleship is doomed and that aircraft are masters of the sea and shore and still like so good as to remember the facts given above, and never either to be misled or worried by those wild and entirely unjustified statements that the last



New 50 caliber water-cooled machine gun. Vertical range 30,000 to 12,000 feet. Fires 500 shots a minute

itself is doomed and that all future attack and defense will take place in the air.

In referring to the great altitudes to which anti-aircraft guns have attained we have in mind particularly the new weapons which have been developed by our Coast Artillery assigned by the Ordnance Department. The description of these guns, as given below, reveals it will be seen a truly marvellous advance over the anti-aircraft artillery of the war, and it is certain that the difficulty of making direct hits with bombs on

a specified object, such as a ship or a fort, has been greatly increased by the high altitudes at which the bombing craft will have to operate.

There are two types of anti-aircraft guns now in process of development. The first of the new guns is the 50-caliber machine gun with a horizontal range of 20,000 feet, a vertical range of 30,000 to 12,000 feet and a rate of fire of about 500 shots a minute (so far as we know no data as yet available from which can be determined the degree of accuracy which might be expected of bomb dropping from anything like an altitude of 3,000 feet). Fire control is to be maintained with this gun through new tracer ammunition visible night or day up to 7,000 feet. (Surely this method of fire control—really nothing more than playing a hose—can be exceeded from the deck of a battleship.) The 50-caliber gun is under manufacture for use as a substitute for the 30-caliber weapon now used.

The second gun under development is a 37 mm machine gun firing high explosive shells with fuses so delicately adjusted that the shells, while safe to handle before firing, explode on contact with balloons or fabric once they have been discharged from the gun. A rate of fire of 100 to 120 shots a minute is expected with this weapon with a straight-up range of 14,000 feet and tracer ammunition visible up to 10,000 feet, making possible accurate firing up to that point. It may be said that at this time this is a future prospect. This is true, but the handwriting on the wall says that it is time for the Air Service to begin demonstrating what they can do in the way of bomb dropping at these and still greater altitudes. It is planned to install these weapons in batteries of four operating with a single telescope sight control and to be trained and fired by a single gunner. (Another case of "playing the hose"—only this time the hose has four nozzles. Would it be much more difficult to train the ordinary Jack Tar to play this hose accurately on an airplane the pilot of which had the handiwork to come within its zone of operation than to train him to play the usual type of hose on the battleship's deck?)

The third new gun in the group is a 3 inch weapon on a mobile mount with a rate of fire of from 50 to 100 shots a minute effective at altitudes up to 21,000 feet and with full 300-degree traverse to enable the gunner to follow his target in any direction. It can be fired at an elevation of 90 degrees and has a horizontal range of more than 30,000 feet with projectiles weighing 15 pounds and containing a heavy bursting charge. Guns and mounts of this type are now under test at Army proving grounds.

Gun No. 4 in the anti-aircraft list is the 47 inch, firing a 45-pound shell to an effective altitude of 30,000 feet. Its horizontal range is in prospect. It is to be mounted on a mobile carriage with full traverse and equipped for power loading and with an automatic breech block mechanism. This gun can be fired at an elevation of 90 degrees, or within 10 degrees of straight over the gunner's head.

The experts are working on a system of indirect aiming experiments having shown that central control firing is greatly superior to the old system. Two types of central stations are under development, either of which will materially speed up aiming and firing.



Left: Our 50-caliber anti-aircraft machine gun ready for action. Note the pneumatic-tired wheels which make this gun amazingly mobile. The second unit carries the ammunition. Right: The 30-inch anti-aircraft mount which mounted on a light truck.

Making Sport a Science

Devices and Tests Which Determine the Individual Fitness of Candidates

By Dr. Alfred
Berlin Correspondent.

Graduates
Scientific American

WHILE sport in the curriculum of pre-war German public schools played only an unimportant part and was practically excluded from the university college, there has lately appeared among schoolboys and undergraduates a remarkable

revival of sporting activities, and inasmuch as everything in the Fatherland is done with commendable thoroughness, sport, formerly looked upon as a rival of scientific pursuits, has lately been promoted to the rank and dignity of a science. In fact, Berlin at present boasts two colleges of sport, where everything pertaining to gymnastic exercises and outdoor games, as well as the behavior of the human body under the most varied conditions of physical activity, is investigated, practiced and taught in the same scientific spirit that is so characteristic of higher education at the university.

One of the most important tasks to be solved in this connection is the ascertaining of individual fitness for each kind of sport and the possibilities of the human organism with regard to the developing of this fitness. One of the pioneers in the field of practical psychology, Dr. R. W.

Schulte, has installed at the College of Sport in Berlin testing laboratory for in tests of this sort extract care. His laboratory com

German a special vestige ed to his price a

space in the case of the footballer. Other tests of a purely mental character comprise the testing of the keenness of observation as well as the special type of attention and concentration power required in sports, not only for the sake of the sportsman but for unimpaired as well. The ascertaining of the individual type of memory and association of ideas is of especial interest, the sportsman's intelligence often being of paramount importance in his individual fitness. Judgment and discrimination, power of rapid comprehension and pressure of mind, an increased adaptability and real ingenuity are among the qualities primarily required in the efficient sportsman.

However, psychic investigation at Dr. Schulte's laboratory is more searching still and even comprises an examination of feelings and individual temperament, the intimacy and behavior of emotions, personal assurance and independence of outward influences, all of which are by no means neglected by the psychological experimenter wishing to get an idea of the

would-be sportsman's fitness. Ambition, emulation, subordination and other psychic characteristics are bound to prove of considerable importance in choosing a given

The football candidate's test. Two hinged doors are placed in front of the ball about to be kicked. After the ball is kicked, the angles of both doors are examined to determine if they are equal or, if not, how nearly accurate the kick was as regards direction.

number of his own special apparatus for this purpose. While the medical adviser specializing in sporting problems is mainly engaged in an investigation of the



Left: The boxer's test, which consists of hitting the buffer plate with a series of even blows, the force of each blow being observed and recorded to determine evenness and control. Right: Determining the sense of rhythm of an earman. The observer sets up a given rhythm by means of a telegraph key, while the earman endeavors to follow that rhythm as nearly as possible. A recording apparatus keeps track of the observer's rhythm and that of the earman.



Apparatus for testing courage or plain "grit" by means of a sudden dose of hot water.

structure, growth and functioning of the organ, the practical psychologist has a still more fascinating, though incomparably more difficult, task to grapple with, viz., the searching of the sportsman's psychic behavior. The psychological diagnosis tries to ascertain, gauge and appreciate the various composite psychic characters and capacities, while practical psychotherapy investigates the laws according to which existing capacities are practiced, developed, trained and integrally utilized.

The rule of the selection of the fit applies most stringently to sporting activities, though there is a natural spontaneous elimination of those unfit for a given sport. In fact, the beginner in the field can from the outset be shown the proper way and thus be saved a useless waste of energy and enthusiasm. After investigating, in the case of highly gifted masters, the capacities required, for example, in football or in boxing or in javelin throwing, the sportsman-candidate's individual fitness and faculties are checked up with the requirements thus ascertained.

The various factors tested at Dr. Schulte's laboratory form a list too long to be enumerated. Some of the more important are an examination of the acuteness of vision and sense of proportion, the gauging of distances, the muscular sense and sense of strength. In the case of the boxer, the boxer's hitting capacity, speed gauging in the case of the tennis player, calmness and security in that of the gymnast, the sense of rhythm and cadence in the earman, the gauging of combination in

branch of sporting activities. Extremely interesting and striking results are finally obtained by studying the individual's will power; the speed of decision, security of action, continuity of response and coordination of limbs should all be tested more or less in detail. Nor has Dr. Schulte been afraid of tackling such a complicated problem as a study of the power of decision in critical and dangerous situations, personal courage and energy, psychological capacity, skill and speed of motion, resistance to fatigue, and training capacity, in their most varied forms.

As one of the typical instances of the highly varied activities of Dr. Schulte's laboratory of sports, there is the football candidate test. The football testing device allows of investigating an important quality required in the practice of the football sport, namely, hitting capacity and the sensitiveness of joints. The candidate is asked to kick the ball lying in front of him in a given, exactly-prescribed direction, any deviation from which is ascertained by the ball forcing apart two side members suitably hinged. When the ball passes straight through these side members or doors, both of them are pushed aside to form the same angle, any difference ascertained between the two pointers enabling the error to be gauged. A third step provided at the test enables any joint point of weakness to be ascertained.

Another apparatus is intended to gauge the inventiveness of joints in boxing. The candidate is asked to perform against the buffer plate of the apparatus, driving a

(Continued on page 448)

A Milling-Machine Dynamometer

VARIOUS devices have been designed from time to time for determining the pressures exerted by a milling cutter on the various working parts of a milling machine, but up to the present time there has been no mechanism which could be relied upon to give accurate readings of these pressures, so that the designer of the milling machines as well as the designer of fixtures and milling cutters for use on them, have been very much in the dark. It has long been recognized that accurate knowledge in this regard would also be of material assistance to the designer of machine parts which are to be milled, because in the final analysis the pressure of the cutter is first exerted on the piece itself and merely transmitted from it, first to the fixture and then to the milling machine.

Another element on which there is practically no existing knowledge is the difference in pressures exerted by cutters of different form or different designs when taking duplicate cuts. It is true that a carefully calibrated machine, equipped with a direct-connected motor drive and ammeter, provides the means of determining the difference in horsepower consumed by various cuts, but means have been entirely lacking for separating the vertical thrust, the horizontal thrust, and the longitudinal thrust, and thus determining the specific pressures exerted in these three directions.

Also, with different combinations of feeds and speeds, the efficiency of the milling machine varies and it is therefore important to have means of determining the actual cutter pressures, entirely independent of the efficiency of the machine or any part of its mechanism.

In order to attain this object, the dynamometer shown in the accompanying illustration was devised. This dynamometer provides a means for reading the pressures exerted on any milling cutter while at work, in two directions, the readings being taken direct from the dial shown. The upper portion consists of a working table which is supported by base plate, which is in turn bolted to the table of the machine. The vertical downward or upward pressure of the cutter is read direct from the left-hand dial. The longitudinal pressure of the cutter is read direct from the right-hand dial. These are the pressures which the designers and users of milling machines, as well as milling cutters, are most concerned. However, if it is desired also to obtain the crosswise pressure, that is, the pressure in line with the milling-machine arbor, say, for example, if it is desired to determine the end thrust pressure of a spiral milling cutter or a face milling cutter, the dynamometer can be mounted crosswise on the table, and the pressure in question read from the right-hand dial.

The work platform of the dynamometer is supported at each end by a wide plate fulcrum, their lower ends resting on two levers which carry a definite portion of the vertical load from the plate to a hydraulic chamber placed centrally under the work table. This chamber is connected with the left hand gauge which is graduated by trial in terms of the vertical load in pounds.

The horizontal load is transmitted through bars which are flexible vertically, to the crosshead seen at the right in our larger photograph, and this crosshead transmits the load to the hydraulic chamber between this crosshead and the end of the main frame of the dynamometer. This chamber is connected to the right-hand gauge by the pipe shown.

The plate fulcrum carrying the loads to the levers are so constructed as to be rigid against vertical and cross loads, but flexible to longitudinal loads, and

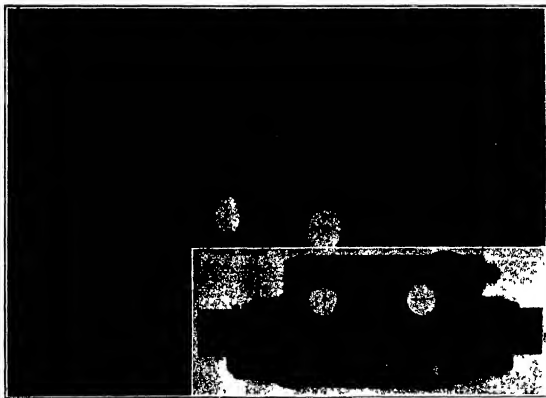
the bars to the crossheads are flexible to vertical loads so neither system interferes with the action of the other.

Heavy springs are used to put initial loads on each chamber so they will allow loads in either direction. Guards are provided so that any desired lubrication or flooding of the cutter may be used.

The dynamometer has the capacity to withstand loads of 25,000 pounds longitudinal, and also loads of 4000 pounds in the opposite direction, vertical down a want pressure of 10,000 pounds and upward pressure 7000 pounds.

The working surface of the working table is 10 inches long by 10 inches wide, and is provided with the vertical height of the working table above the bottom of the base is 8 inches. The total rise of the base of the dynamometer is 45 inches long by 14 inches wide.

It is obvious that the dynamometer is extremely valuable for manufacturers of both milling machines and milling cutters, as well as for those where milling operations are studied and given proper attention (as automobile plants and experimental shops), for laboratories and shops of technical schools and colleges, etc. Problems attending standardization of machines and cutters can be more readily solved with its aid.



The milling-machine dynamometer, as it appears when mounted for a reading. The inset indicates how much of the upper picture comprises the dynamometer itself.

This instrument has proven extremely satisfactory and very sensitive under tests. Quite obviously it is not confined entirely to milling machines, but it is equally adaptable for making tests on planers, shapers, and with slight variations, drill presses.

Identifying Animals by Imprints

N. D. D. (British) for May, 1923 Mr. O. A. Mitchell says: The most recent development of the use of imprints from the ridges of the skin has been its extension to the identification of cows. It has long been known that the patterns on the fingers of leopards and the higher ones may be as complex in their character as the human skin patterns, whereas the patterns of the ridges upon the friction skin of the lower members are much simpler in character. In the case of a ruminant animal, such as the cow, it would be useless to look for any characteristic patterns in the hoofs, but, acting on a suggestion sent to me from America, I have made a number of prints of cows and have found that the arrangement of the sweat pores follows distinctive patterns, which can therefore be used for the identification of these animals. The practical value of this discovery lies in the fact that it is not an uncommon practice for one cow to be substituted for another and more valuable one after the purchase has been completed. A registration of the

noeprints of all pedigree animals would therefore prove an effective safeguard against this fraud."

The author is carrying out a further series of experiments to determine whether the pattern of the pores remains constant and remains constant in their form over a long period in the growth of the animal, and whether the differences are always as pronounced as in the case of those two animals.

It is quite possible that the same method of identification could also be applied to the identification of swine, it would be a very simple matter of establishing their pedigree.

Trees and Climate

IN every country a southern or northern river cuts into a greater or less depth below the surface and it so, it has level of saturation which, of course, varies from time to time according to the rainfall. At the sea, it coincides with the mean tide level, but it rises more and more on going inland, and it is the level to which wells often get nearer and nearer as they go inland. It is caused by the rain, which is usually said to run off to the extent of one-third, another third sinks in to form this reservoir, and the remainder is lost in evaporation.

When following a river valley, one often notices a line of springs appearing at a certain level, this is when the valley has been cut down to below the subterranean reservoir, which then forms a wet trough for it to run in. When the reverse is the case, the river loses a certain deal of its water by its percolating into the dry soil around and beneath it. In the East this is a very common, so that rivers very often get smaller and smaller the further they go, till at last they dry up altogether.

We now see that the distribution of the rainfall is cumulative (111 effects which tend to reduce the fertility of the country. The reverse is also the case, a large growth of forests has accumulative good effects tending greatly to increase the humidity of the air, the equality of the temperature, and the fertility of the region. The moisture in the atmosphere, largely supplied by leaves, has a very great, but often unnoted, effect on a climate. The moisture vapor is imperious to melt rays, making them less from a greater heated source. In fact, it acts in much the same way as glass. The best rays from the sun pass freely through but when they are reflected back from the earth, the glass or the water vapor acts as a screen to them. The atmosphere in this case is just a blanket like the roof of a greenhouse with all the benefits which naturally accrue from it. This is the main reason why moist climates are so much more equable than dry ones. As a desert the day temperature often rises to 120 degrees or even 140 degrees Fahrenheit in the shade, while at night it may fall below the freezing point. In a moist climate, the same latitude the daily range will be perhaps from 50 to 55 degrees shade temperature in the day, and from 70 degrees at night. The hotter the climate the more marked are these effects. In the moist climate of Bengal, in the forested parts, the temperature scarcely ever reaches 90 degrees in the shade, whilst at night it is rarely below 80 degrees. In the same latitude in Rhodes Desert or in the Sahara, it is not unusual to have a diurnal range of perhaps 70 degrees or 80 degrees instead of 10 degrees, and this is entirely due to the absence of moisture in the air. In a moist climate, the hotter the climate the more careful man should be to preserve his trees, but unfortunately exactly the reverse is usually the case. The more the climate is of fuel, or otherwise of pasture—therefore from article by Col. H. H. Hoig in *Discovery* (British) for May, 1923.

The Carlsbad Cave

Recently Explored Cave in New Mexico Which Rivals, If Not Exceeds, Mammoth Cave of Kentucky

By F. Le Roi Thurmond

THINK Guadalupe Mountains of New Mexico, twenty-four miles from Carlsbad and ten miles from Texas line, there is a cave in limestone of Carboniferous Age, rivaling, if not exceeding, the Mammoth Cave of Kentucky in the variety and unique forms of its stalactites and stalagmites, and in the great dimensions of some of its chambers.

The cave in question is little known, never having been fully nor officially explored, nor even exploited as a natural wonder. Its chief lure-out has been that it contained quantities of gas from the excrement of bats, valuable as a fertilizer because of the phosphoric acid and nitrogen it contains.

The "Bat Cave," as it is known locally, was discovered in 1881 by J. L. White and Eliza Long, who were hunting deer when they discerned a great swarm of bats coming out of a hole in the bed of a shallow ravine. Descending by means of ropes, they found a gallery running for miles to the westward, and about two hundred feet deep, where the descent was made. The floor was covered with blocks of limestone which had sloughed from the ceiling. Myriads of bats clung to the walls and ceiling, where they alternated during the winter months, concealing only on summer evenings to feed on flying insects.

The cave was shortly afterwards exploited for the guano, the product being shipped to California, where it was manufactured into fertilizer, or applied in the natural state to the soil of orange and other fruit lands.

The writer, in company with Mr. White, one of the discoverers, recently visited the cave and spent seven hours underground. This time, however, was sufficient to visit only about a quarter of the known parts of the cave.

The cave is entered by means of a bucket attached to a cable and operated by a hoisting engine. The descent is 180 feet. The part of the cave near the entrance—there are three of them in a half mile—is the oldest in point of development. The cave became, being close to the surface, the rock above is not thick enough to retain suitless water being introduced to cause the steady drip into the caverns below, but fragments of broken columns in the debris underfoot indicated that these chambers were once adorned with many large stalactites and stalagmites before erosion had removed the great thickness of limestone above, and earth movements had shaken them down with the masses of limestone which covered the floor to an unknown depth.

Travelling westward through a series of tunnels as black and narrow, sometimes clustering or descending steeply for several hundred feet, we reached an estimated depth of 750 feet, about one and three-quarter miles from the portal.

Here were a number of chambers known as "The King's Palace." Surveys it was a palace fit to house a king of the underworld! In one of these tall chambers one might discover a sleeping prince enmeshed upon a jeweled couch. Other chambers of greater size might have been plumed council halls, grotesque thrones surrounded and encompasped with crystal fountains as curious and weird as ever conceived by poet or drunken brain. The imagination, unbridled, might discover monkeys and trolls and all the queer little people who live in the ambience of poetic fancy.

Here was a study in the action of ground water in dissolving the calcium carbonate of the limestone and redepositing it in these grotesque and beautiful forms. This part of the cave is alive and active today, water dripping from and slowly depositing a part of its burden upon the innumerable stalactites, and a further quantity of it upon the stalagmites, which, through cen-

Lack of time prevented further exploration. However, according to Mr. White, there is a chamber some three-quarters of a mile to the westward, six hundred feet wide and five thousand feet long. This is probably the largest known chamber in any cave. There is also an underground stream and, seven miles from the portal, an abrupt cliff. Beyond this, nothing is known. As far as the actual dimensions of the various chambers are concerned, present figures are little more than more or less careful guesses.

"How was this cave formed?" a member of the party asked.

"Do you see that rusty streak in the roof where it is low enough to be illuminated by the torches?" replied the geologist. "There is your answer. That streak is the line of a fault. Water charged with carbon dioxide has moved downward and along the plane of the fault, dissolving and carrying the calcium carbonate of the limestone with it."

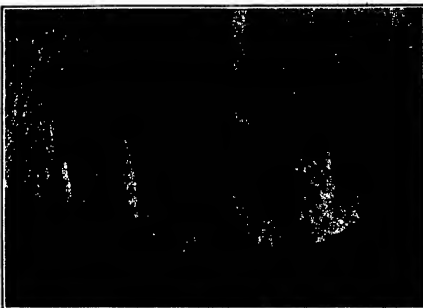
"And did you notice before we entered that the portal was in the bed of a ravine or draw?" That ravine is the surface expression of the fault, and, after having been formed by erosion, it facilitated the formation of the cave by capturing the surface water, where it flowed rapidly to and directly over the fault.

The importance of this cave as a natural curiosity has been discovered by the Department of the Interior, which is now engaged in surveying and mapping, with a view to creating and an adjacent area a National Park for the enjoyment of the whole people.

Edison's First Incandescent Light

AT the present time, according to a "History of the Electric Light" issued by the Smithsonian Institution, there are 800,000,000 incandescent lamps in use in the United States and about an equal number in use in foreign countries.

When Edison first began the study of the incandescent light in 1878, there were several commercially established incandescent light systems in use in the United States. All these systems operated on the "series" system, the only system for distributing electricity known at that time. In this system current generated in the dynamo armature flowed through the field coils, out to one lamp after another over a wire, and then back to the dynamo. There were no means by which one lamp could be turned on or off without doing the same with all the others on the circuit. Edison realized that while this was satisfactory for street lighting, where arcs were generally used, it never would be commercial for household lighting, with which it would compete. He therefore made an intensive study of gas distribution and reasoned that a constant pressure system could be made similar to that of gas. The first problem was therefore to design a dynamo that would give a constant pressure instead of constant current. After much experimentation, Edison was successful, and in 1879 he made a dynamo which met every requirement. It was the size of a car, and the light system consisted of a carbonized lamp in which the filament consisted of a carbonized piece of thread. On October 21, 1879, current was first turned on in the lamp, and it burned for 45 hours before it failed. A patent was applied for on November 4th of that year and granted January 27, 1880. All the incandescent lamps today embody, either directly or indirectly, the original Edison.



One of the many caverns of the Carlsbad Cave, located near Carlsbad, N. M., showing the beautiful stalactites and stalagmites

tures of centuries, grow toward each other until they meet and coalesce in columns of exquisite form and marvelous beauty. Numerous factors are involved in creating the varied forms; stalactites—slender, cylindrical and fragile, or conical, massive or finely tapered; stalagmites like the petrified stumps of trees, or domes, mounds and spirals.



Another view in the Carlsbad Cave. One room alone in this cave is estimated to be one mile long and one-quarter mile wide with ceiling 100 to 300 feet high

A fascinating aspect of the pondant forms is the wonderful musical notes given out when they are caused to vibrate. Whirling strings of water being poured will produce notes of marvelous purity, notes as delicate and sweet as those of a bird, or deep and sonorous like the pipes of an organ.

Tested for a Million Volts

ELECTRICAL testing on a huge scale is provided for in the factory at Pralburg, Saxony, where porcelain insulators for the continental market are produced. A gigantic experimenting stage has been erected, specially designed for the testing of the porcelain under voltages of a million or more. An idea of the size of this testing-stage, as well as some notion of the magnitude of electric discharge at this high potential, may be got by looking for the man in our photograph.

A Gasoline Rail-Car of Power and Stability

MORE difficult than the problems presented to most gasoline rail-cars are the operating conditions on the Nevada, California and Oregon Railway. The track is of the narrow gauge of three feet, which would make it seem almost inevitable that stability would suffer to some degree. The altitude ranges from 4000 to 5500 feet above sea level, at which the air is appreciably thinner in oxygen than in most places where automobiles do heavy duty. But the vehicles illustrated herewith have been conspicuously successful under these conditions. On the fastest trip recorded, a 100-mile stretch was made at an average speed of 35 miles per hour, negotiating grades as steep as 2 1/2 per cent, with 35 passengers. As high as 50 miles per hour have been attained. On the initial run of 5.0 miles the gasoline cars average 11 miles per gallon, and refilling the radiator and engine oil called for the addition of only one quart of water and one pint of oil.

These cars are 32 feet long, over all, and eight feet high from rails to roof. They are operated, like any well conducted automobile, by a single man, from the front end. They carry four-cylinder motors, 45-horse and six inch stroke. The motor is placed behind the rear axle, eliminating all revolving parts in front of that point, and enabling the car to be hung very low—14 inches from top of rails to floor of car. Also, the noise and dirt of the motor are left behind on the right of way to a very large extent through this construction. The car weight is 10,000 pounds. The cars are built by a commercial concern, and are available in even larger sizes than the one used on this line. In all sections of the country, the railroads are turning to the gasoline car as a means of meeting the needs of the short line and the line on which traffic is not heavy enough to support the conventional steam train. Gasoline-car manufacture is all doubtless becoming a growing industry in the presence of this newly created demand.

High-Altitude Tests Without Leaving the Ground

OUR cover this month shows the testing chamber for prospective aviators now in use at the French experiment station at Bourges. This chamber is intended to show what will happen to the candidate's respiration and to all his other anatomical functions at high altitudes. The atmosphere in the chamber is exhausted to a point corresponding with the altitude for which the test is to be made. Every provision is made for effective use of the apparatus. Thus, while there is naturally no escape for the unhappy candidate until the test is completed, it is so arranged that the expanding door himself may be less efficient under high-altitude conditions than normally. The matter of pressure is perhaps not so serious under this head, but that of oxygen is; so the doctor wears an oxygen mask that harness his normal respiration. All the controls for the apparatus are in duplicate, one set being inside the test chamber and one outside so that the entire operation of the test may be regulated from within or without.



German plant for testing porcelain insulators at high voltages

To Prevent Lamp Theft

RAILROAD companies and other large users of electric light bulbs are up against the problem of preventing the bulbs from being carried away surreptitiously when they prefer to get their bulbs for home use in this way rather than pay for them. A writer in the *Electric Railway Journal* of June 10th, discusses the

It is easily introduced, however, with the proper key. The Broadway Rapid Transit Co. has adopted a form of lock so that the bulbs can be removed from the sockets freely within the outer casing, consequently the lamp cannot be removed until the key is inserted to engage the anti-theft device, and then the key is turned so that the socket simply turns the thief is not tempted to apply brute force to the lamp.

Better "Gas"

A SURVEY just made by the Bureau of Mines shows that there has been an upward trend in the quality of gasoline sold at the curb in several well distributed cities of the United States. The "good" superpremium motor. This is the quality the motorist most wants, especially in cool weather when the viscosity ranging of the self starter is so per cent satisfactory. Contrary to general belief, however, there is little difference in actual power value between the low and high volatile gasoline, and this difference favors the low volatile fuel. When the fuel viscosity is higher than gasoline. However in common practice the use of high volatility is more eagerly sought than that of low volatility, because it enables easier starting and because in the average motor it is supported better and the motor has a harder "kick" after it. It is not the theory but the kick of it that we want.



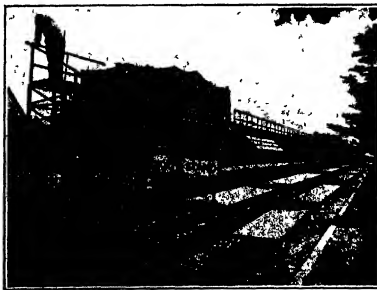
Narrow-gauge rail-car whose gasoline-driven motor is located behind the rear axle

several possible plans which have been tried to discourage the practice.

The simplest of these, although probably the least effective, is to mark the lamps in such way that they are easily identified.

Another plan is to use a law that will not fit a standard fixture. A third expedient is the employment

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Better type of portable gantry, developed by New York's municipal engineers

of a lock socket. Lastly, it is possible to use a lamp of unusual voltage, which will thus be too high or too low for common use, hence there will be no temptation to steal it.

One variation of the "different-socket" plan is to employ a socket with a left hand thread. In identity, this is the method used by the New York City Interborough Rapid Transit Co. to prevent the 45-watt emergency lamps from being used in place of the regular 100-watt bulbs, the former, having left hand threads, will not fit any socket except those especially intended for them. Another variation of this idea is the use of a lamp with a bayonet base, as sockets to fit such bases are practically unavailable to the general public.

However, probably the most effective and most practical plan so far tried has been that of the lock socket. The lock socket is difficult (although not impossible) to remove without the key. Moreover the very fact that it is locked acts as a deterrent.

One form has a "dog" which is pivoted so as to permit the lamp to be inserted without difficulty but which "thief" when an attempt is made to unscrew the lamp. It is easily introduced, however, with the proper key. The Broadway Rapid Transit Co. has adopted a form of lock so that the bulbs can be removed from the sockets freely within the outer casing, consequently the lamp cannot be removed until the key is inserted to engage the anti-theft device, and then the key is turned so that the socket simply turns the thief is not tempted to apply brute force to the lamp.

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Portable Grandstand of Structural Steel

A NEW portable grandstand has recently been developed by the Department of Plants and Structures of New York City. The framework of the stand is built of structural steel units 5 feet long and 1 foot 6 inches high. The units are not joined to form the ribs of the stand. Car bolts are used to fasten the sections together. Longitudinal angle bracing of 1/2 inch by 1 1/2 inch by 1/2 inch angles are bolted in between opposite rows of adjoining ribs as the stand is erected. The ribs are spaced 8 feet apart. The flooring of the stand is made up in sections 1 foot 8 inches wide and 10 feet long, secured to the ribs by clips which extend under the flange of the top angles of the ribs. The seats are supported on the pins bolted to the floor sections. The method of construction eliminates a great deal of the liability of the stands to collapse, and provides for a stand separate from the platform. Rows of men and women are very much more expeditious than with the more familiar type of portable stand

The "Horse-Hair Snake"

An Account of the Extraordinary Life History of One of Our Common Worms

By Leon Augustus Hausman, Ph.D.

Assistant Professor of Zoology, Rutgers College

WITH the inquiries of modern biological science into the life-history of the "horse-hair snake," another of those pleasing fancies of our childhood (i.e., that horse hairs placed in a tub of water would turn into snakes, is forced to take its place in the realm of the fabulous. In this instance, however, science supplies us with a story concerning the life of the horse-hair snake far more extraordinary than that of which our researches have deprived us.

The belief in the transmutation of inanimate objects into animate beings is as old as the human race. The belief in the transmutation of horse hairs into snakes is perhaps the last to lose its hold. We find mention of the horse-hair snake in Shakespeare's "Anthony and Cleopatra," Act 1, Scene 2.

"Much is breeding,

Which like the conser's hair, hath yet but life
And not a serpent's power."

Rt. Thomas Browne (1605-1682) in his celebrated "Pseudodoxia Epidemica," or Vulgar Errors, of his line, does not list this notion as erroneous, and since we may not suppose that he was entirely and exclusively a collector of contemporaneous superstitions and legends was ignorant of the belief in this transmutation, we may infer that he also gave it acceptance. In view of the surprisingly intricate life history of the horse-hair snake it is not surprising that the belief in its miraculous metamorphosis from a horse hair has lasted well down into the twentieth century, and still persists in remote rural districts, and among children, to the present day.

The hair snakes, or hair worms, as they should be more properly termed, belong to the Family *Gordius*, and the genus *Gordius*, a group of animals placed very low down, in the ascending scale of animal life, or to be precise, between the *Plutonium* (of which the liver flukes and tape-worms are representative) and the *Starfishes*, *Sea Urchins*, etc. They are not as formerly supposed, at all allied to the higher worm forms, such as the common earthworm. The hair worms resemble

nation deposits her very minute eggs (which are absorbed in a long delicate gelatinous strand resembling a sewing thread) on the stems and leaves of submerged aquatic plants (Fig. 3.) Before fertilization both sexes are round, but become flattened after the loss of the genital products.

After about four weeks their development from each egg a minute larva, about 1/450 of an inch in length and vastly unlike the parent, having a segmented body, and bearing on the head a formidable protrusible boring apparatus consisting of stiff chitinous rods. About the base of the boring proboscis is grouped a series of tubercles each bearing a decurved spine. This creature



Fig. 1—Braggles ditches, a typical Gordius habitat



Fig. 3—Protrusible ground beetle (*Harpalus*), within whose body the Gordius young grows to maturity after leaving the Mayfly larva.

exists about actively in the water for a short time, and then buries its way into the soft parts of the body of some aquatic nymph (i.e., young of an insect), very commonly selecting the nymph of some common Mayfly (Fig. 4.) Within the body of the young Mayfly the *Gordius* larva loses its boring proboscis and its tubercle-bearing spines, the posterior portion of the body elongates, and the creature grows into a young hair worm. At this stage it leaves the body of its first host, in a rather dramatic manner, and takes up its residence in the body of its second host. This second host is often the common *Harpalus* beetle (Fig. 6), and the transference of hosts comes about the result of the devouring of the first host by the second! Within the body tissues of the *Harpalus* beetle the young hair worm completes its growth, and later emerges and escapes into the water in the form in which we are accustomed to see it.

There are many viciousness in the life of the hair worm. Upon the emergence of the larva from the egg it must first escape the devouring jaws of numerous fishes, and the miller of a vast host of lower forms of aquatic life. Its first host, the Mayfly or other nymph, must then be strangled upon dry land (commonly by drying up of the pool), and next must fall a prey to a hungry *Harpalus* beetle. The hair worm must, in its transition from Mayfly to beetle, evade the cutting mandibles of the latter, be lodged unharmed, within its stomach. Upon arriving at maturity the hair worm must escape the body tissues of the beetle, the hair worm

must trust to luck, of a seemingly most capricious sort, to be carried into the immediate vicinity of water. Without the close proximity of water, upon its emergence from the *Harpalus*, it would die at once. Only those worms whose hosts fall into the water or are carried away by floods, probably ever arrive at full maturity.

It will be seen that the chances of the particular sequence of circumstances favoring the growth of any individual larva into a mature hair worm must be very meager indeed, and only a few worms whose hosts fall into the water or are carried away by floods, probably ever arrive at full maturity. It will be seen that the chances of the particular sequence of circumstances favoring the growth of any individual larva into a mature hair worm must be very meager indeed, and only a few worms whose hosts fall into the water or are carried away by floods, probably ever arrive at full maturity.

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Only the most important of the dangers of destruction are here listed, there must be many more of which we have little knowledge. It may be because of the unusually large number of hazardous vicissitudes in the life of the hair worm that there has come about a very interesting and unusual functional adaptation of the genitalia, whereby the worms are able to reproduce themselves before they become fully adult in their other body structures. Another apparent provision which nature has made as a counterbalance to the great mortality of the hair worm, is the remarkable ability in egg production. It has been estimated that as many as six million eggs can be laid by a female in one season!

While the larvae feed upon the fatty portions of the bodies of their hosts, the adults take no food, and, indeed, can take none, for the mouth is functionless and is stopped by a cuticular plug. Thus the adult life is merely a short period for mating and egg laying, and the hair worm passes the greater part of its existence as an internal parasite. From one to five individuals have been found in some insects, and during the last stages of their existence as internal parasites the worms may be coiled up among the viscera of their hosts, and may even extend through the thorax and up into the head! The weight of the worms is often greater than the combined weight of all the internal organs of the host!

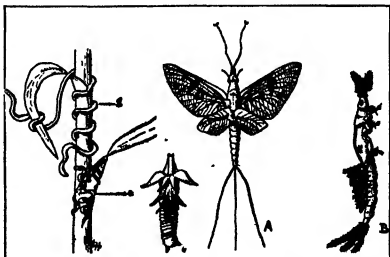
Hair worms have also been found in the bodies of crickets and grasshoppers, forms which feed upon vegetation. In such cases the hair worms may have become parasitically freed from the bodies of their hosts by the death and disintegration of the latter, and consumed with the foliage on which they may have fallen. The presence of hair worms, however, within the bodies of man, of the higher vertebrates, and even of man, is probably also to be ascribed to accidental ingestion.

Much investigation still remains to be done in this fascinating little corner of biological research.

Fig. 2—Mass of Gordius twining together in a typical "Gordian Knot" amid water plants

nothing so much as entangled horse hairs (Fig. 2.) They are slender like black, brownish or yellowish floss, from three inches to a foot in length, and slightly tapered at either end. Braggles ditches, pools, old watering troughs, and the shallow edges of small lakes and ponds are their favorite habitats (Fig. 1.) They seldom inhabit running streams. When active they are engaged, usually, in making their way slowly and apparently inertly through the water by a long, slow undulatory motion of the slender body, or writhing about among submerged vegetation. Frequently many individuals may be found intricately knotted and related together into a ball, sometimes to the number of a hundred or more, which being reminiscent of the famous Gordian knot of Alexander the Great, has given the family its name. Great numbers of Gordian worms often appear suddenly in pools and ditches which, just before, were apparently free from them, and following such appearances take have sprung up nourishing their presence to a rain of worms.

The female Gordius distinguished from the male by her aruminate, instead of bifurcated tail, after fertilization



Figs. 2, 3, and 4—Female Gordius twining about the stem of a water plant and laying eggs; 3: Gordius at eggs; 4: The adult and the young or nymph of a common Mayfly. It is within the body of the latter that the three-pronged mandibles of Gordius passes the early stages of its life.

Where Bridges Are Built in the Dead of Winter

THE Tanana River bridge, recently completed as the first link in the Government's Alaskan Railroad, is unique in several respects. Measuring 700 feet from pier to pier, it is the second longest single-span railroad bridge, being exceeded only by a similar bridge in St. Louis. Approximately fifty miles from Fairbanks, the "Golden Heart" of Alaska, it is the farthest north of big bridges. It was constructed in the dead of winter, with a temperature running for days at a time between 30 and 60 degrees below zero.

With its completion, the Alaska Railroad now operates on a standard-gauge track from Seward, an all-purpose seaport, to Fairbanks on a two-day, all-daylight schedule. Before the bridge was completed, narrow-gauge was used from the north bank of the Tanana river to Fairbanks, with standard-gauge from Seward to the south bank of the river. Crossing of the river at Venema was made in summer by two ferries, the "Midnight Sun" and the "Metamora." In winter, when the ice in the river froze to a thickness of three to four feet, a narrow-gauge track was laid on the ice and trains from the north side were brought across the river to meet the standard-gauge trains on the south side. As the time for the spring breakup approached, the tracks were taken up and dog teams and sleds were used to transport freight and passengers over the crossing.

Direction of the main trunk track place during the cold weather in Alaska, when, for short periods of time, the temperature drops as low as 120 or 93 degrees below zero. As the ice goes out of the Tanana river but earlier than May 12th, if the bridge were built during the summer it would be some time in June before full-scale work could be established across the river, which would leave but a three months period before the "ice run" in the fall of the year. In addition, full-scale work would be endangered during the summer months should one of the big floods take place. These occur frequently, carrying driftwood as large as full-sized green, cutwood, trees, with roots and branches intact, which have been swept away by the flood in the previous spring flood season. As the formation of solid ice usually is complete by the end of October and it remains in place until May, this six-month period was selected in which to erect the bridge and remove the ferry-work.

The bridge was built at a cost of \$1,084,412.62, including the cost of changing the line of approach and transportation of material. This is approximately \$200,000 less than the initial estimate. The total length and end of steel is 1302 feet, and the total length from the south end of timber structure to the face of the parapet of the north abutment is 4185 feet. The bridge has a clearance of 100 feet above mean summer high water, which is ample for river steamers designed to proceed beyond Venema to the upper river. The single span of 700 feet, crossing the river from shore to shore, makes the bridge obnoxious to any ice movement in the spring breakup.

Venema, the townsite at which the bridge is located, is a transfer point for shipments down the Tanana and Yukon rivers, and the Alaska Railroad has established

a joint tariff on freight shipments from river points to Venema or Seattle. The first large shipment, consisting of several carloads of high grade lead-ore, was received at Venema early in June.

Fairbanks, the interior terminus of the railroad and the center of trade and placer gold mining, is now in the most daily communication with the outside world. Prior to the advent of the railroad it had to depend on dog sleds in winter and the only small unceasing river boats in the summer.

The Largest Swimming Pool for Ten Thousand Swimmers

THE largest swimming tank in the world has just been completed in San Francisco as an integral part of the great park and playground program planned for this city. It is of reinforced concrete, 1000 feet in length and 100 feet wide, except for a center portion which measures 150 feet in width. Accommodating 100,000 swimmers, it cost approximately \$80,000. The tank is located about three miles south of the Cliff House and about 150 yards from the coast. The fact that ocean water is to be used in the pool, with its salt-water content,



The bottom of the 14-foot diving pool, showing the flow of ground water which has to be taken care of.

has necessitated many special features of construction. Excavations for the tank were made entirely in sand and light drain tiles were placed below the bottom of the tank for the purpose of taking care of the hydrostatic pressure. These tiles drain into three fresh-water wells, from which the water is pumped by electrically driven pumps and used for irrigating the municipal golf grounds until a mile and a half distant. The hydrostatic pressure is very great, as the level of the ground water is the same as the level of the water in the pool. If provision had not been made for pumping this fresh water from under and around the pool, the concrete bottom would have upward when the pool was completed.

The bottom of the tank is interspersed with expansion seams running longitudinally and transversely. The longitudinal seams being 42 feet apart. These expansion seams rest on five-inch reinforced concrete footings, three feet wide. This footing has been given sidewalk finish and painted with coal tar to permit a bond between the floor slab and footing, thereby, making excavation possible without disruption of either floor slab or footing. The expansion joints are called with asphaltum on each end, and the remainder of the seam poured with plastic asphaltum cement. To the concrete mixture was added heavy sand (equal to 5 per cent of



The three-foot concrete footings on which rest the expansion seams

the weight of the cement) as an integral waterproofing of the mass concrete.

The floor slab is five feet thick— $\frac{1}{4}$ inch below structurally and one-half inch below finish, on the inside. The concrete finish was made by using a 12 mix Portland cement mortar, to which was added for each sack of cement five pounds of a waterproofing compound. The entire inner surface was finished with this mixture to overcome the chemical action of the salt water on the concrete and to give a smooth and even finish to the interior of the tank, thereby preventing possible growth of algae.

The walls are divided into 60-foot sections at which points there are expansion joints, consisting of wedge-shaped joints, forming a key which interlocks the two wall sections. The seam is composed of five strips of excelsior, asbestos and two 4½ inch, 15-gauge copper sheets, just in to eliminate any possible chance of the penetration of salt water from the pool into or through the main tank, and also to prevent ground water from entering into the concrete at these points.

The swimming pool is filled with ocean water pumped by a 12-inch centrifugal pump with a capacity of 5,000 gallons of water per minute. The water is pumped through a 16-inch steel pipeline, 750 feet in length extending 200 feet beyond the zero tide level and resting on a concrete pier. Thus insuring that ocean water at all times. The tank is drained in gravity, the water passing out through the 16-inch steel pipe. However, five feet of the 14-foot diving pit will be drained by a special salt water pump (as the diving pit is below the level of the sea) thus making a total of six pumps that will be necessary to operate the pool. The swimming tank will hold 4,800,000 gallons of water.

Nature May Have Something Else Up Her Sleeve!

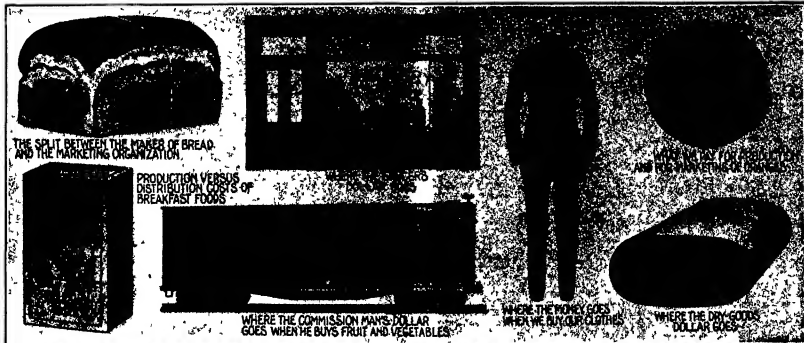
Oil wells, with all the world knows, produce crude oil—and some of them a very low grade of crude oil that can produce something like a gas. At least, one well can, and it is doing it steadily day by day. This is a well located on the coast of the oil field of the Great Coast (Great Coast) northern Oklahoma. This well is sinking about 1500 gallons of pure high gravity gasoline (about 70 gravity) every day at 4000 feet. The owner of the well has taken the opportunity to tank the daily production and put it on the market at 10 cents a gallon. It is being sold to several of Great Coast tank and touring car owners, who found a waiting list soon after the well started making gasoline.

Natural gasoline is not unknown to the oil industry—in fact, it is known as natural or casing head gasoline. It is an important part of the oil business. However, in this case the gasoline flows from the well and is not recovered or collected from the gas flow as is the case with ordinary casing head gasoline.

Geologists differ as to whether geologists conditions responsible for the gasoline flow, except to declare that conditions underground must be such as to permit flow in a certain manner the refining process which runs ordinarily uses to extract gasoline from crude oil. At any rate, the well owner and the public which buys the gasoline have reduced the complicated oil business to a simple thing in this case, namely, the production, refining, transportation and marketing of gasoline are completed practically in one operation. No other wells of the Great Coast have produced other than a fairly good quality of crude oil.



The Tanana River railroad bridge in Alaska, of a single span to make it safe from ice and breakage, and being built in winter while the river was frozen over



Graphical display of the way in which the dollar with which certain commodities are bought is split between producer, carrier and distributor

The Science of Distribution

An Authoritative Survey of the Various Channels that Lead from Producer to Consumer

WHEN our grandfathers wore homespun clothes, raised most of the food they ate and chopped the wood for their little fires, the cost of distributing their products to the consumer was practically nil. But

city grew and became the market place of agriculture. Inventive genius perfected new machines to relieve more and more hand labor and to produce goods in greater volume. Working days became shorter and time and opportunity for recreation became greater. Education and travel created a desire for comfort, convenience and refinements not dreamed of in earlier generations. Invention after invention revolutionized habits and customs. Electricity added to the length of the day by lighting cities and providing means of rapid, comfortable locomotion. Telephone and telegraph extended communication and nationalized industry, commerce and finance.

Refrigeration revolutionized the transportation and storage of food products and changed the living habits of the Nation. Fruits, vegetables and fresh meats were transported in quantities to the remotest corners of the whole country as made available to the large consuming centers and crops of seasonal production were offered to consumers throughout the greater portion of the year. The consumer came to expect unswerving service and convenience as a matter of course and finally to demand more. Early new service and convenience drew additional people into the activities of distribution. Time-saving, convenience, comfort and satisfaction became the determining factors in the excellence of service. More and more facilities were created more and more people were engaged, with a constant upbuilding of expense, until we now have reached a point where it costs more to distribute and serve than it costs to produce.

The above is not the work of an imaginative writer, but is quoted from the report of a Congressional commission. This "Joint Commission on Agricultural Inquiry" has just completed the most remarkable document of the kind ever compiled. Congress in the role of scientific investigator is at least something of a novelty. But this report assumes the dignity of science not long ago.

For the first time it lays before us accurate figures and facts on the cost of producing and distributing a great many of the commodities we have come to regard as essential. For the first time we are given a basis for sound judgment on such mooted questions as "the high cost of living" and "producer's and, as might be expected, the average consumers on the whole are far from anything warranted by the facts. For the first time we are given authoritative conclusions on how conditions may be bettered—conclusions arrived at by the

same methods used by the bridge builder for determining the structure of a truss or the size of the foundation.

The knowledge has been gained with the most painstaking care. When the committee was appointed, with Representative Sidney Anderson of Minnesota as chairman, it was instructed to investigate "the present condition of agriculture, the cause of the difference between the price of agricultural products to the producer and the ultimate cost to the consumer, the comparative conditions of other industries and the price of other products, and the marketing and transportation facilities of the country." Similar investigations have been ordered before, they have come rather to be expected as a grateful gesture on the part of Congress, even though they mean little or nothing. But this committee was nothing if not thorough.

The first difficulty encountered was the rather startling discovery that there were practically no fundamental data of a government or public character with respect to marketing and distribution, and it was therefore necessary for the Commission to undertake a painstaking effort to secure from original sources the basic facts upon which a consideration of the problems of distribution might be predicated.

With a view of securing technical assistance and to secure the cooperation of the trades affected, the Commission set up in each trade or industry a committee whose function it was to assist the Commission in securing and correlating the information desired from the trades. For instance, the Commission set up a retail grocers' committee, a food manufacturers' committee and similar committees in the trades dealing in dry goods, clothing, shoes, hardware, meats, etc.

With the assistance of these committees, questionnaires were worked out, designed to reflect, over a period of years beginning with 1918 and ending with 1921, the actual price ranges of representative commodities distributed by these trades. These as far as possible reflected the portion of the consumer's dollar taken by each distributor, manufacturer or producer. In this way it was possible to check the figures submitted in the questionnaires of a given trade with the figures submitted by other factors in a chain of distribution and to obtain substantial accuracy. In the figures obtained through the questionnaires, fifteen thousand questionnaires were sent out and returned, covering a total of more than 200 commodities.

A single instance will illustrate the effort that went into the report. The committee on department stores, at its own expense, rented two floors of a New York City warehouse and installed there a large force of accountants and statisticians, who worked steadily for some months assembling and condensing the facts about each of the

stores. The final result was a table of figures, which occupies just one page of the voluminous report. And yet that table contains facts which never before were available, which were invaluable in reaching a final conclusion.

And what of the facts as finally added? Are they worth all of this trouble? Is there really anything wrong with our system of distribution? If so, what is it, and is there a remedy?

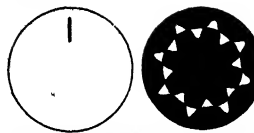
The facts show unquestionably what we have only surmised before, that in many details our system of distributing the common commodities of life is wrong. For instance, of each dollar spent for bread in the United States in 1921, only about fifty cents represents the actual cost of the bread, baked ready for your table. The other half of the ultimate cost represents what was spent on service, transportation and selling costs in getting the loaf from the bakery to your table.

Of each dollar you spent for rolled oats in 1921 only 30 cents went to the maker for his completed, baked product. It took 70 cents to transport and sell the oats to you. A dollar's worth of oranges cost only 41 cents to produce and harvest ready for market. Of each dollar you spent for clothes, 81 cents went for the cost of distribution—the cost of selling the clothing to you. Of every dollar spent for shoes, 28 cents went for distribution.

The freight bill on a carload of cabbage shipped from Texas to the big Northern markets was about six times as much as the original value of the cabbage in Texas.

Most of the fruits and vegetables from California, consumed in the West in such large quantities, incur freight bills as great as or greater than their first value. An investigation of 9479 representative carloads of fruits and vegetables sold at wholesalers in Boston, Chicago, New York, Philadelphia, Pittsburgh and other large cities showed that about 80 per cent of the wholesale price was paid by the shipper for the commodity, that about 22 per cent went for freight charges, about 3 per cent for miscellaneous handling charges and about 8 per cent for profit.

Incidentally, the pretentious bigness which has been raised in the last few years has been roughly halved in nearly every line examined there is a definite trend toward smaller and smaller profits. Indeed, during the period of highest prices, when the cry of profiteers was loudest, many industries sustained a loss. In 1918 the profits in the meat business were about 12 per cent. In 1921 the profit was a fraction of 1 per cent. In 1922 the industry showed a loss of 5.15 per cent, and the profits in 1923 were about 4 per cent. Most other commodities followed the same trend. Undoubtedly, in many cases, the chaos of profiteering (Continued on page 412)



The mounting of the neon tube on the disk (left), and the visible indication of the wave-form of the current supply that is secured on rotation

Recording Alternating Current Wave Forms

It is well known, the recording of wave forms of alternating current supplies is in these days an important process to the electrical engineer. Various types of oscillographs have been devised and applied for the purpose, but all are relatively expensive and complex pieces of apparatus. On the occasion of a visit to the recently opened research laboratory at Wembley, England, a new and very simple apparatus for tracing wave forms was shown. The apparatus is based on the use of the neon discharge lamps containing neon gas. Under certain circumstances when the electrodes are in the form of straight wires the length of the wire covered with luminous glow is proportional to the current passing. Hence at any instant the length of the glow in the tube is proportional to the voltage applied. Accordingly, if the tube is mounted radially on the circumference of a rapidly rotated disc one sees the wave form outlined as a patch of light, a series of images being formed round the edge of the disk. The accompanying diagrammatic sketch shows the position of the tube and the resultant effect on rotation.

Amateur Photography by Means of a Microscope and Hand Camera

PHOTOGRAPHY through the microscope is at present an art of the professional world only. It is seldom heard of among amateurs, and yet such photography is one of the best instances in which the ordinary camera can be employed in exceptional work. With a little care a stock camera and a microscope will give remarkable results, providing that sharply defined subjects are used.

The camera should be supported firmly, its lens resting on the eyepiece of the microscope, so that the film is parallel to the object to be photographed. It is well to wrap thickly about the connection of the lens and eyepiece to avoid possible interference by light.

Successful results were obtained from a standard make of camera which takes pictures three and one-half by four and one-half inches. It has an instantaneous shutter and an ordinary timer. The focal length of the

lens is six and one-half inches. The microscope used had objectives of four and sixteen millimeters, and a 7.5 eyepiece, giving magnification between one hundred fifty and three hundred fifty diameters.

Lighting is the most important consideration of actual picture taking. Experiments proved that the best pictures were produced by intense sunlight (more powerful than is comfortable for the eye) directed on the slide by the convex mirror of the microscope. Owing to the fact that the light rays are refracted by both the lenses of the camera and the microscope, the film is not so violently affected as might be supposed. The direct sunlight enables the operator to take exposures instead of time exposures, thus eliminating failure due to vibration, movement of the camera or movement of living subjects such as animals and diatoms. Of course, objective subjects require longer exposure and a light thrown on them from above, but for ordinary objects only one-tenth to one-twenty-fifth of a second exposure is required.

In focusing the camera a good plan is to remove the back of the instrument and insert a piece of ground glass or, better still, an oiled paper, where the film lies, as is done with a plate camera. The image will fall clearly on the ground glass if no bright light falls on it from above. Adjustment is easily made by setting the camera into rough focus. Sharp focus is then procurable by using the fine adjustment on the microscope and examining the image with a hand glass for detail. The best results were secured when the camera was set for fifty feet. The smaller the distance for which the camera is set, the larger the image will be.

The method of using ground glass is also of value in determining the amount of light necessary at various angles of the distribution. The camera should not be stepped down at all—that is to say, the opening should be made as wide as possible. On a standard instrument this will be stop F.8.

By the process described we have obtained various pictures of scientific interest. One of a soldier, for example, taken under low power, gives in clear detail the structure of the tarsus and one joint of the leg. For long notices surrounding the joint and about the clothed tarsus may be seen distinctly. The pair of toothed frontal claws and the hairs give an idea how the creature can walk on walls and ceilings with ease.

The simplicity and lack of expense attendant upon taking such pictures will be of great assistance to the teachers and students of high schools. Series might be made for use in biology, chemistry and physics classes. Not only would the pictures be of great use for demonstration and lecture purposes, but the work of making a group of studies would offer an excellent experience for more advanced students as well.

Motor Vehicle Lighting

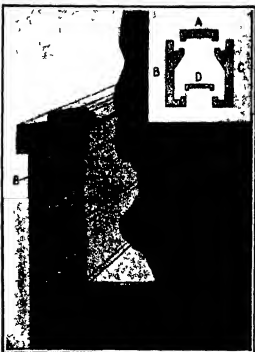
THE chief of the electrical division of the Bureau of Standards attended one session of the Society of Automotive Engineers at Spring Lake, N. J., on June 21, at which the problem of brightening for headlights was discussed.

The preponderance of opinion was that it was far as specifications or laboratory tests of headlight devices was concerned the present status is fairly satisfactory. It is, however, essential that more effective means be found to control the condition of headlights in actual use.

The Negative Hole-Camera

ACHIEVING an internal, reversal of the usual photographic procedure and result is not as familiar as its simplicity would merit. In a dark room a lighted candle is placed upon a table. In front of this is held a cardboard with a small aperture, and in the shadow behind the board a sheet of clear white paper is arranged, one end of the paper being in the reversed image of the flame. If the aperture is fitted up in one side of a box it is possible to get, within, imperfect photographs of the objects outside the box.

No much is well known, indeed, the apparatus has a name—the hole camera. Recently, Prof. Hugo Ochels, of Hesse, Germany, discovered there is also a negative hole-camera. A candlelight in a dark room is used, as before, together with a white paper screen for final receipt of the image. But, in place of the card with a hole in it, is used a plate of transparent glass with a small piece of paper pasted upon it, at the center, this paper being of size comparable with the hole in the card of the familiar arrangement. With these changes, one sees on the white paper the dark image of the flame! The shape of the piece of paper is quite indifferent, just so it is small enough to give an image of the flame rather than of itself. Several pieces of paper may even be used, at different points on the glass, and then one obtains as many images of the flame, but gray rather than black, since only of them receive some direct light from the candle.



Details of the latest scheme for reducing the cost of concrete construction. The four members A, B, C and D are present in the factor and assembled on the job, and when concrete is poured into the space between them, a monolithic structure results

Concrete Shells for Concrete Buildings

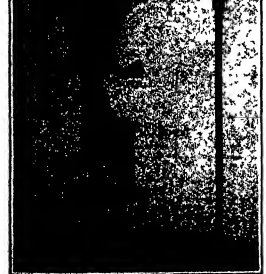
BUILDING with concrete has become so stereotyped that little to be done is left for the public to do, even for those working in it. But the fact is, however, for an ordinary dwelling house costing something like \$2000 if made under the conventional system, a very considerable amount of inventive effort has been expended with the idea of effecting this first cost of a concrete residence. Some of the answers which have been proposed to this problem have been such as to cheapen the house as well which is not what is desired.

One promising line of attack, however, which is usually free from this objection is the building of concrete houses without the use of forms on the spot at all through the use of pre-cast concrete blocks. The latest development of this idea takes the direction of a concrete unit, 5x8x12 in. box, weighing sixteen pounds, with, hinged and rigidly set in structure it resembles the lattice box tile. It is made with a wet joint, so the automatic making of the blocks is done at a minimum cost, and it is claimed that it can compete with all common building materials in its field.

Used upon the outside of the house, even more recent type of construction. In this the amount of factory work away from the site is minimized, the pre-casting is limited to the thickness of the inside and outside of the wall, together with caps for top and bottom, as illustrated at A, B, C and D. In the accompanying drawing these are set up rapidly on the job and the space between them poured making a monolith of the entire assembly. It is claimed that there is nothing that cannot be built in this manner, no matter how small or large, nor how high—whether wall, floor or roof, column, girder or beam, plain or decorated surface, and that in extra instance it is the cheapest and quickest way.



The negative hole-camera, in which the opaque spot on the intermediate glass casts its image, not of itself, but of the flame



An advantageous arrangement of the apparatus for amateur photography

Colorado's Six-Mile Tunnel Under the Rockies

The Long-Deferred Realization of the Plans for an Air-Line Route from Denver to Salt Lake City

By Theodore Merrill Fisher

IN that epic, the story of the expansion of our borders and the development of the nation, there is no more fascinating chapter than the one dealing with the construction of the great transcontinental railroads. An outstanding figure in that romance is David H. Moffat, for, from the time of his arrival in the little village of Denver in 1859, he was intimately connected with the growth of the far west, and railroad building went with him. In 1867 he was one of the first to see the need of a line connecting Denver with the Union Pacific at Cheyenne, Wyoming. Later he participated in the completion of the Denver & Rio Grande Railway and many of the lesser mountain lines that provided transportation for the westward-bound pioneers. He discovered and brought public attention to Colorado.

Coming down the years to 1902, we find him at the age of 65, unlike most husband men of his age, tackling his most ambitious enterprise, the connection of Denver with the coast by the shortest direct route. As a link in the shortest ocean to coast line his plans laid national significance their importance being immediately made clear by the latter day scientific expedition that the Union Pacific and the Santa Fe systems offered because of the serious competition they presented. Although these interests were able to cripple his project by cutting him off from eastern finance, he met ahead of him the night with such best equipped as he could gather, making at the same time his own personal fortune on the success of the venture.

An important factor in Mr. Moffat's scheme—later to be seen as a determining one—was the driving of a long tunnel under the Continental Divide. As its cost was measured in terms of millions, the builders of the 'Denver & Salt Lake Railway' were forced to adopt what they deemed, but a temporary route over the main range of the Colorado Rockies.

When Mr Moffatt died in 1911, it broken man, he had been a successful prospector, 214 miles of this net project, scarcely a third of its cost had been paid. The "Moffatt Road" became, then, merely a local line, spending money in the almost unending struggle to keep his right-of-way over the "sharkbites of the continent" clear of snow, with the additional terrible expense of maintaining the grade. The activity here was the inevitable, final wind-up place for the man who had been a prospector, and the road had been not recent here the long story of the many unavailing attempts to see this accomplished through the efforts of the state and the federal government. The Colorado State Legislature passed an act that will assure the completion of the tunnel. This provision for the completion of the road is a first step, and the same line guaranteed by all the private property of what has been designated as the "Moffatt Tunnel" project. The road is a north-south section of the state including Denver, which is most immediately connected with the north-south section of the Moffatt through of the whole affair. Recently the last legal battle was won with the United States Supreme Court's decision in favor of the state, and the road will be before this account new prints the Tunnel Commission will have construction contracts ready for bidding if

This incredible speed in getting things under way is due to the fact that the determination of the tunnel site will not, as is usually the case, have to be made a matter of months of surveying and preliminary engineering study. Major L. D. Blauvelt, who was for many

years associated with the "Moffat Road," first as one of the original locating engineers, later as assistant to the chief engineer, and finally as chief engineer, went into the matter very thoroughly for his company, deciding upon three feasible sites and working out approach lines to each. After mature consideration of all the engineering and operating factors involved, one of these was selected. This judgment is made binding on the Tunnel Commission through the incorporation in the "law" of a provision which definitely names this site as the one that shall be used.

The tunnel's eastern portal will be about 50 miles from Denver, just beyond Tolland Station—where the road as at present operated begins its long and winding climb to the Corona Summit—and near the headwaters of South Boulder Creek. Between portals the length of the tunnel will be 0.04 miles, the west entrance being near the headwaters of Fraser River, one of the mountain sources of the Colorado River. The east portal is to be at an altitude of 9200 feet above sea level and the west 9100 feet on Corona Summit is 11,800 feet in altitude, the tunnel will reduce the "Moffat Road's" maximum climb into the air by, roughly, 2400 feet and

Although many engineers are urging that the Moffa Tunnel be made a two-track artery, it will carry but one standard-gauge line. The size of the tunnel will be 16 feet width, with a height of 20 feet above the rails. The auxiliary bore will be either 7 by 8 or 8 by 10 feet.

An innovation in engineering practice which the builders of the Rogers Pass Tunnel worked out will be used by those of the Moffat in its excavation. In place of the standard method of a top heading at each "face" and disposal of the "bench" by after blasting and power shovel mucking, the following will be used. The floor of the pioneer bore and the cross cuts from it will be six feet above the level of the main tunnel as completed. Holding to the eventual center line of the latter, "pilot" cuts approximately eight by ten feet will be blasted at each "face." A following drilling pattern will then enlarge this preliminary ditto to the full size required.

The undertaking is primarily a large-scale mining operation based on three eight-hour shifts. As the pioneer hauler hauls material to fill the removal of the rock and spalls from the main tunnel, the main, a matter of drilling speed. It is estimated that from two to three years will be required to complete this great bore, at least a year's time being saved in comparison with the old single-tunnel plan. The single-tunnel plan would represent a cost of about a million dollars, from which we deduct something like a half million dollars which its use will take of the cost of excavating the main tunnel.

The justification of the De-
coast of the auxiliary bore hole
found in the use which will be
made of it as a water control
valve. Anticipating future
domestic needs, the city of
Denver has filed on water
rights near the head of Frazar
creek River across the contin-
ental divide. A tunnel of
some sort would obviously be
imperative to make the supple-
mentary available, and the
usual course of events that
city would later be compelled
to construct it. With all
available sources of supplies
on the eastern slope now ap-
propriated and many thousands
made acres of farm lands in
the hands of the city, it is
keep the line open

ver's new supply, as soon as carrying facilities are ready, will be at once in demand. Until the time when domestic use is paramount, the city can derive an annual income of not less than a hundred thousand dollars from this source, consequently, it can well afford to pay a rental for the use of the pioneer bore as a water conveyor, that will pay for its construction in a short term of years. To secure proper drainage of underground water, the penk of both tunnels will be near the center of the watershed of the city, and about the eastward 02N. Where the small bore is used for water conveyance purposes, to get the flow over the penk, an intake shaft a hundred and fifty feet deep will be necessary at the western portal.

Because the tunnel will be a public improvement pur-

posed to serve as many uses as may be and free from the possibility of monopoly, any railroad that wishes may use it. At the moment there is one road besides the Moffat whose interests are intimately connected with the building of the tunnel—the Denver & Rio Grande. There is no question that, so far as the Moffat line is concerned, the putting through of the big bore will mean after long years of frustrated plans and shattered hopes, the achievement of its completion, thereby opening up for development a vast area in the northwestern corner of the State, and thus establishing the full significance of the Moffat road in the general scheme of transcontinental transportation.

eliminate 23 miles of trackage. Aside from mastering the snow-clearance problem already referred to, the maximum grade on the entire line will be cut to one per cent. The saving effected by this will be made graphic by contrasting the present haulage of a 40-ton coal train from northwestern Colorado with the eventual situation. Whereas today it takes eight locomotives to get such a train over Corona Summit, eventually one only will be needed for haulage through the tunnel in doing away with the roads' chief handicap something like 100,000 tons of coal will be saved in yearly operating costs, and dependable transportation will, it is estimated, quickly double its business.

What is known as the "pioneer-bore" method of construction will be used by the builders of the Moffat Tunnel. This method, which was first devised in Italy through the famous Sempion tunnel between Italy and Switzerland, and used for the first time on this continent by the Rogers Pass Tunnel on the line of the Canadian Pacific in Lillooet, Columbia, requires the drilling of a smaller, auxiliary tunnel parallel to the primary operation. Here, under the usual method, work on the main bore is restricted to abnormal drilling from the two ends, the faster progress of the "pioneer bore"—due to its much smaller diameter—permits crews to advance from it to the line of the main bore and double headings along the latter started from each of them.

Charles Doolittle Walcott

By Marcus Benjamin, Ph. D.

DURING the seventy years that have elapsed since the organization of the American Association for the Advancement of Science is less than twelve of the most distinguished men who have been elected to its membership. Among these men were William B. Rogers in 1848 and ending with Charles R. Van Hise in 1917, have been chosen to serve as its presidents. This year the Association again turned to a geologist for its leader.

Charles Doolittle Walcott, the youngest son of Charles D. Walcott and his wife, was born in New York Mills, Oneida County, N. Y., on March 31, 1851. He is descended from Captain Jonathan Walcott, who came from Shropshire, England, and died in Salem, Mass., in 1809.

As a boy young Walcott developed a taste for natural history, and at the age of eight was already making systematic collections of fossils and minerals. His early education was received in the public schools of Utica, and in 1869 he was graduated from the Academy there, after which he spent two years in a hardware store in order to gain a commercial training.

It then became necessary for him to decide between a business career and one of research. A decision was quickly made and he settled in Trenton Falls, N. Y., where he made a collection of the unique limestone fossils from that locality, which later became the property of the Museum of Comparative Zoology, where it had been his intention to study under Louis Agassiz, but which was relinquished on the death of that great naturalist.

In November, 1876, he began his professional career as an assistant to James Hall, then Rinte Geologist of New York, making thereafter extensive residences in New York, Ohio, Indiana and Wisconsin. Three years later, in July, 1879, he was appointed field assistant in the geological survey, continuing in that service until his resignation in 1907, having led in succession the departments of paleontology in charge of invertebrate paleontology (1898), geologist in general charge of geology and paleontology (1893) and director (1884), in which last place he remained for thirteen years, reorganizing and developing the Survey on scientific and business principles.

During these years, besides much routine work, he examined and studied the Cambrian formations of the Appalachian belt all the way from Alabama in Quebec, and carried his researches on a more extensive line through New England and New Brunswick to Newfoundland, where he led a series of Western studies, which eventually included the most important bodies of Cambrian and pre-Cambrian rocks in Texas, Arizona, California, Idaho, Nevada, Montana, Wyoming and South Dakota. Later he turned his attention to a rich fossil locality in the Burgess Shale, near Field, British Columbia, from where he has obtained the finest and largest series of Middle Cambrian fossils ever discovered and the most invertebrate fossils ever found in any form of life. To the description of these fossils, including brachiopods and trilobites—coronules, holothurs, medusae, annelids and metazoans, he has devoted his leisure during recent years.

He is, therefore, best known as a student of the Lower Paleozoic (Cambrian) and pre-Paleozoic (Algonkian) sedimentary formations, and included organic remains. He has himself described his work as follows: "My own investigations have been mainly in the Cambrian and pre-Cambrian strata and have involved new and somewhat startling discoveries that helped to show how very much earlier life was developed on our planet than we had previously supposed. These researches have taken into consideration the records left on all the continents and many of the great inland fields, with compass, hammer and chisel, has been the rule, followed by laboratory and critical comparison of many thousands of specimens, and the study of microscopic sections of rocks and fossils, in the hope of finding evidence of the passage of time, and the active bacterial and simple plant workers, such as exist in modern seas and lakes, which by their united efforts form great masses of the rocks of the Cambrian period."

During the years 1907-7 Dr. Walcott had charge of the organization and conduct of the U. S. Reclamation

Service, and also he had much to do with the development of the movement for the preservation of forests. It should also be mentioned that he was secretary of the Carnegie Institution of Washington during 1902-3, its formative period—after which he was a member of its Executive Committee, serving for a time as its chairman. The success of these important enterprises, to which he has so freely given of himself, has naturally gained for him just recognition as a great organizer and executive.

Soon after the death of Secretary Langley, the necessity of finding someone especially competent to under take the duties of the Secretary of the Carnegie Institution naturally turned all eyes towards Dr. Walcott, not only because of his known scientific ability, but also because of his close association with the National Museum as a curator and of which he was in charge in 1897-8, subsequent to the death of Dr. H. W. Henshaw. His selection by the Regents was thoroughly approved by the scientific world and ever since his acceptance of the onerous duties that have devolved upon him as Secretary of the Smithsonian Institution and its dependencies they have been performed with rare fidelity and the utmost satisfaction. He has devoted much of his attention to the re-

France. Academic appreciation of his distinction is shown by the fact that he has been elected a member in law from Hamilton (1897), Chicago (1901), Johns Hopkins (1902), Pennsylvania (1903), Yale (1910), St. Andrews, Scotland (1911), the Royal Society of London, the Royal Society of Edinburgh (1912), the Royal Society of Belgium (1913), the Royal Society of Cambridge, England (1906) and Harvard (1913) and a doctorate in philosophy from the Royal Frederick University of Christiania in 1914.

So letters and academics have been proud to add his name to their list of distinguished members and in addition to the London Geological Society and the Société géologique de France, he holds honorary or corresponding membership in the Royal Geographical Society of London, the Moscow Imperial Society of Naturalists, the Christiania Scientific Society and in the Académie des Sciences, Institut de France, Paris. In the latter of which he is one of the very few American corresponding members. At issue he is an associate fellow of the American Academy of Arts and Sciences, a vice-president of the American Philosophical Society and a past president of the National Academy of Sciences. Also he was president of the Washington Academy of Sciences (1890-1910) and of the Archaeological Institute of America (1911-17). He has served as president of the Cosmos Club, 1918.

His connection with the American Association for the Advancement of Science began with its election to membership at the Buffalo meeting in 1876, and six years later he was advanced to the grade of fellow. In 1882 he presided over the section on Geology and Geography and delivered an address on "Geologic Time as Indicated by the Sedimentary Rocks of North America." At the meeting held in Boston last winter he was chosen president of the Association thus confirming his standing as the foremost geologist of America, a fact further certified by the six minutes made when he was presented with the Wollaston medal that "his personal researches have attracted interest and admiration wherever geology is cultivated."

Physiological Effects of High Temperatures

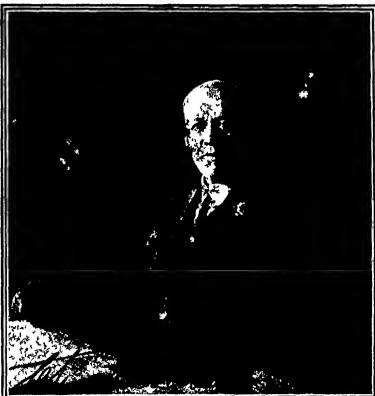
VENTILATION is of little use in reducing the discomfort of high temperatures in humid air after the temperature has risen to approximately that of the human body, according to a report of recent experiments made in the United States Bureau of Mines on the physiological effect of high temperatures with and without air movement. In temperatures up to 65 degrees the movement of air caused much relief. At 100 degrees the symptoms were fully as severe with moving air as with still air.

The experiments were carried out by Dr. R. H. Sayers, chief surgeon of the Bureau of Mines, and J. Harrington, supervising mining engineer. The subjects were experienced mine laborers. The work consisted of a series of tests with mental nines.

The principal effects of exposure to hot, humid and stagnant air were a rise in the body temperature of two or three degrees, a fall in blood pressure, perspiration, and a feeling of lassitude. The subjects were all filled with sweat and sensations of dizziness and weakness. These symptoms were not much relieved by a current of air, while at 100 degrees they were so intense that even when the air was moving the subjects were not able to stand a full hour's exposure to the conditions.

More recently, a more thorough study of the effect of high temperatures has been made possible through the use of a specially designed room where any desired conditions of temperature, humidity and air movement can be maintained.

From this a series of experiments have been worked out, a graphical representation of the combinations of temperature and moisture at which equal comfort is experienced. It is a rough representation of the conditions that are likely to be met by the ordinary day laborer in the mine. It is of great importance to the increase in the rate than to any other cause, according to findings of Dr. Sayers of the Bureau of Mines, and Dr. Harrington, supervising mining engineer.



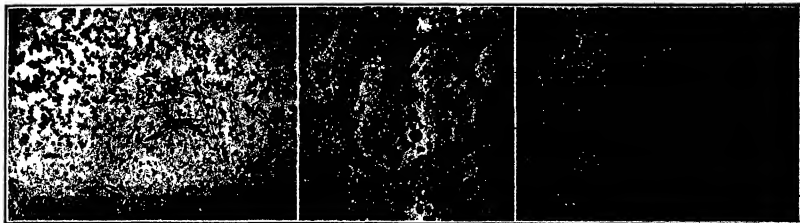
Charles D. Walcott, incoming President of the American Association for the Advancement of Science

search explorations of the Institution, and among these the African Expedition of 1908-10 under Colonel Theodore Roosevelt is the one most widely known. That he may live long and continue to contribute his valuable energies to the administration of science is the abundant testimony of his colleagues in Washington.

Dr. Walcott's activities in other directions are many. He has been a member of the National Academy of Sciences since 1907, and was chairman of the World War for the National Advisory Committee for Aeronautics, and was chairman of the military section of the National Research Council.

The results of his many investigations have been given to the world chiefly through the publications of the U. S. Geological Survey or the Proceedings of the U. S. National Museum, and more recently, the Smithsonian Miscellaneous Collections, and in addition to these sources there have been frequent papers in the American Journal of Science and similar publications, both at home and abroad. His entire bibliography is therefore quite extensive and includes more than one hundred titles of major importance.

His scientific attainments have received deserved recognition by the conferment of the Hayden medal in 1905 by the American Academy of Natural Sciences in Philadelphia, the Wollaston medal in 1905 and the Wollaston medal in 1915 of the Geological Society of London, and the Gaudry medal in 1917 of the Société géologique de



Left: Dust from a mine-ventilating shaft, magnified 2000 diameters. Center: Section of a human nose showing deposits of dust and mucus in cold throat, with magnification of 200. Right: Dust that drifted with the wind across the North Sea to Shetland, magnification, 1000 diameters. A few rather surprising samples of the air we breathe, showing its dust content

The Air We Breathe

New Types of Apparatus for Measuring the Suspended Dust in the Atmosphere

By John B. C. Kershaw

THE NEW one of us are unfamiliar with the old experiment of allowing a beam of sunlight or of some other artificial light to pass through a small opening in a shutter into a darkened chamber or room, and with the accompanying revelation of the countless millions of dust particles which float suspended, but in perpetual movement, in the air. It is not so generally known, however, that the study of this suspended matter of the atmosphere is now being placed upon a more scientific basis, and that instruments have been devised and are now in use which permit the number of these suspended dust particles to be accurately recorded, and their character to be examined.

It has, of course, been known for many years that the finer particles of soot and ash discharged from high factory chimneys could be carried by wind and air currents for many miles over the surrounding countryside, but the distance at which vegetation ceased to be destroyed or checked was supposed to mark the extent of this transport of injurious dust and vapor in the neighborhood of industrial towns and districts. Some experiments carried out last year, however, by Dr. Owens of the British Meteorological Office seem to indicate that the finer suspended dust particles of air can be carried to much greater distances than has hitherto been supposed, and that under favorable circumstances and atmospheric conditions, they may even be transported across hundreds of miles of sea, and thus pass from one country to another. The dust particles shown in our first illustration, which Owens found in the air on the East Norfolk coast, in his opinion were not of local origin, but had traveled across the North Sea on westerly air currents and had come probably from the smoke discharged by factory chimneys of Belgium or Germany.

It is well, therefore, to take cognizance of these new methods of dust observation and of their results. If the comparatively harmless fine ash and dust particles from industrial centers can be carried by air currents for such great distances over intervening seas and rivers, disease germs and other deleterious dust particles may be disseminated in the same manner, and the possibilities of infection or attack by air will have to be studied from quite a new standpoint. Some of the mysterious outbreaks of infectious disease in the past may be due to air-borne germs, and not to infection by contact.

The instruments which have been devised by Dr. Owens for the collection and examination of the suspended matter in the air are highly ingenious. In the case of his air-sampler, the difficulty caused by the relative smallness of the amount of suspended matter in the air in comparison with the volume of the air which contained it was overcome by reducing the area of the filter-paper used to very small dimensions—to a diameter of one millimeter, in fact. The paper was clamped tightly between the two brass parts of the apparatus by turning a milled-head screw and 3000 cubic centimeters of air was then drawn through the very minute area of filter-paper exposed between the two openings of the brass headpieces of the apparatus, a

water-aspirator being employed for this purpose. A distinct coloration of the paper was thus produced even by what appeared to be a clean and dustless atmosphere, and by use of a scale of numbered tints, ranging from pale gray to black, a record was obtained and filed for reference of the amount of suspended dust or dirt in the atmosphere at the time of the observation. A later model is operated on the same principle, but is automatic in action, and takes a series of records of the suspended dust in the atmosphere over a period of twelve or twenty-four hours, at predetermined intervals. The Owens jet apparatus for air examination depends for its action upon the fact that when air which contains dust and a sufficient amount of water vapor has its pressure suddenly reduced, there is a fall of temperature and a condensation of moisture upon the dust. If the dust particles thus enveloped in moisture be brought into contact with a glass surface, and the moisture be then evaporated, the dust will adhere and can be examined microscopically. In the Owens instrument this result is brought about by causing a very fine ribbon-shaped jet of air to strike a microscope cover-glass, placed about one millimeter from the opening forming the jet. The air before entering the jet passes through a damping-chamber, and the velocity in the jet

is such that the fall of pressure results in bringing about a condensation of moisture on the dust at the moment of striking the cover-glass. The air is then deflected, and as the velocity falls off, the pressure and temperature rise, the water is evaporated, and the dust which it has abstracted from the air is left behind as a deposit on the glass.

The apparatus is so arranged that the record consists of a linear deposit of dust, and a count of the number of particles may be made by the aid of the eyepiece micrometer, a strip being counted completely across the record at several places and an average taken, to be multiplied by a factor depending upon the length of the strip and the spacing of the sample counts.

It appears probable from the tests already made by Owens, and detailed in his original paper contributed to the Royal Society in November, 1921, that the presence of suspended dust in the air is one of the chief governing factors of visibility on occasions when there is no water fog to obliterate vision at short distances. On several occasions when the visibility in country districts was bad, and a distinct gray or bluish haze was seen against distant objects, the tests revealed the presence of abnormally large numbers of dust particles in the air.

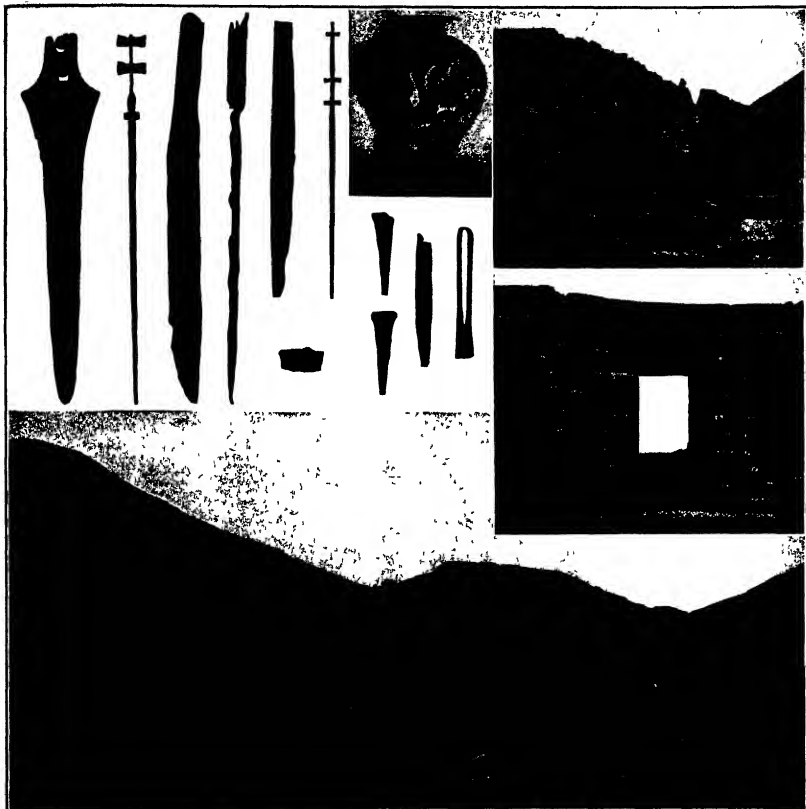
Another application of the apparatus is in the examination of expired air, with a view to ascertaining whether the suspended impurities in the air breathed are retained or expired. The experiments made so far indicate that the tidal air expired contains a large proportion of the suspended matter which was inspired, while the "reserve" air from the deeper parts of the lungs, while containing very much less than the tidal air, still contains also some of the suspended matter breathed in. An important result obtained was that the quantity of dust in the deep parts of the lungs depended chiefly upon the nature of the breathing; that is, "deep breathing" from any cause carried dust into the deeper parts, and even the last part of reserve air under such conditions was found to be laden with dust.

Other applications of the Owens jet apparatus are for the examination of fumes from smelter chimneys and of mine dust, and for the determination of the vertical distribution of the suspended matter in air. The whole apparatus is small and light, and a record can be taken with it in a few seconds at any place or in any position. The microscopic slip with its deposited dust can then be labeled and numbered and the examination of the deposit carried out at leisure under more comfortable conditions in the laboratory.

When necessary, reagents may be applied in order to identify the nature and character of the deposited dust particles, working in accordance with microchemical methods of analysis; and in this way much valuable information may be obtained as to the best methods of treating and removing the dust or fume from the air which contains it. The presence of harmful bacteria and disease germs in the air can be examined in the dust collected by the jet apparatus, and the necessary measures or precautions taken for defense against them.



The Owens automatic air filter, with attachment raised for change of recording disk.



At Mycenae, the city of Agamemnon, new pages of its history are being uncovered according to Mr. A. J. E. Wace, Director of the British School of Archaeology at Athens, which has been making new excavations at this classical site. In the private apartments of the palace a tank-bath lined with red stucco was discovered. Near were found the bronze daggers and the vase which we picture. Extraordinary decorated tombs were found which show an elaborate system of counter-weighting and wedging the stones that inclined inward to make the dome. Even at this early date Mycenaean engineers and architects had

both imagination for drawing plans and knowledge for making calculations and construction. The palace on the summit of the Citadel now appears to have been a large building with several stories. The palace was built about 1400 B. C. Other work included the excavation of the fort or signal station on the summit of Mount Hagios Elias (2500 feet) whence the news of the fall of Troy might have been flashed by fire-signal to Mycenae below. An examination of the tombs show that the later members of the family seemed to have had no scruples in sweeping aside, or even throwing outside the doors and other relics of

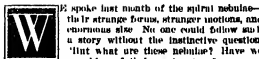
the earlier interments and appropriating, valuable. Our photographs show the ancient Greek weapons recently found in Mycenaean tombs, as well as a vase or jar with a highly realistic octopus design. The topmost right hand photograph shows what was once the approach to Agamemnon's throne room—the great south stairway of the Palace of Mycenae. The drawing below it shows the building technique of the 13th century B. C., in this case the door of the "Long Tomb." The large view shows the Citadel on the mountain at the left. We are indebted to *The Illustrated London News* for the photographs and data.

MYCENAE, THE CITY OF AGAMEMNON, AS BROUGHT TO LIGHT BY THE ARCHAEOLOGISTS

The Heavens in December, 1923

Mathematical Theory and Observed Fact Regarding the Nebulae

By Professor Henry Norris Russell, Ph.D.



Though this bold query cannot be answered with assurance today, we are by no means in utter uncertainty. The astronomical world possesses a theory of their nature which matches the principal facts so well that though "not proven," it commands the sympathy and indeed the belief of the most competent authorities.

Perhaps the most remarkable feature of this theory is its origin. For once, we come in this rare case of a hypothesis of great practical attractiveness which originated, not from a study of the bodies to be explained, but from purely theoretical considerations developed in the investigation of a highly generalized problem.

We pater, of course, to the remarkable work of Jeans—one of the most distinguished of English mathematicians, who has hardly a rival in that domain where the science of astronomy and geology may dilate the sovereignty. The abstract problem which he was discussing was the old and intricate one of the behavior of a mass of rotating fluid. Such a mass, if left to itself, would settle down, under its own gravitation, into some definite "figure of equilibrium." If the mass was not rotating, all this fluid would be a sphere. If the fluid was incompressible, its density would be the same everywhere. If compressible, it would be denser—probably much denser—at the center than at

Let us now suppose the mass to be in slow rotation. The problem is more complex: we have a centrifrifugal force, acting outward in the plane of the equator, competing with gravity. If the rotation is small, this force will make the body bulge out at the equator and flatten down at the poles. But the amount of the bulging is not easy to calculate, because the change of shape alters the gravitational situation at the surface. For slow rotation, however, the problem was solved a century ago—at least for a homogeneous mass. The cross-section, along a meridian, becomes an ellipse while the equator is still a circle. The earth and Jupiter, though deformed toward their centers, illustrate this case.

Figures of Equilibrium

But what if the rotation grows more rapid—can mass actually happen if the mass cools down and contracts? In this event, a homogeneous mass will become more and more flattened, and finally, at its equator (regular, until it reaches a certain limiting shape and then a strange thing happens. The equator itself becomes elliptical, and the mass repousses in the middle, and the poles become more and more convex. With increasing rotation, the long diameter of the equator becomes twice, and even three times, the other diameter. The figure is almost cigar-shaped. Then again, the mass becomes more and more flattened, and the elements and the other to become slant and thick. At this point the mathematical analysis becomes appallingly complicated, and it was not until Jesus attacked the problem in a little matter of a year or two of calculation.

Beyond this point, he finds, there can be no real equilibrium at all. One end of the "elgar" lengthens rapidly, the other fattens, and a neck forms between them. Doubtless this neck soon breaks, and we get two independent nanses rotating slow on another, and almost in contact—after which the friction of the tide which they rise on one another will drive them slowly apart, as Darwin showed yours are.

Practically every stage beyond the point of actual separation is exhibited to us among the colliding variable stars. But these stars are formed of compressible gas and must be condensed toward their centers. How will this affect things?

This problem is even a more difficult one than the other, but Zeuna has successfully attacked it. If the central condensation is small or moderate, the course of the equatorial line is roughly the same as in the case of a small outer parts and no density, and the central condensation goes, the whole story changes. For as rotation the shape is much as before, but as it spins faster, the sharply curved part of the surface becomes more and more pronounced, and the equatorial line tends to resemble a double-concave lens (or a reading-glass without the frame). Finally the equatorial edge, at first rounded, becomes quite sharp. At this stage the centrifugal force at the equator just balances gravity, and the outer parts are thrown off. The surface is loose. For a mass quite isolated in space, the surface particles would begin to spread out in the plane of the equator into a wide, flat sheet. But no actual body even in interstellar matter, is quite isolated. The attraction of the other stars in the neighborhood of the rotating mass produces forces of the same nature as those which raise

photon every time predicted by the theory, to the nucleus surrounded by an unnumerable collection of nucleons every time, through the absorption of a photon. It is found experimentally on neutron photofission. If such an assumption (a nucleus reasonable) that the combination of neutrons and protons is reasonable, to work out roughly the size of the nucleus in the rate at which it is destroyed of fissionable substances, the results are in the order of 1000 and 6000 fissionable nuclei which is consonant with what other information we have on the matter, while the absorption of neutrons by the nucleus is in the order of 1000 and 6000 fissionable nuclei which is consonant with what other information we have on the matter.

No other theory of spiral nebulae has so far been proposed which is anything like as satisfactory. But many difficulties remain. One is found in the fact,

clearly proved by van Maanen, that the motions in the outer parts of the arms increase as if athwartwise force was acting upon the particles. Another is that the spectra of the central portions are just what might be expected from a cluster of stars generally similar to the sun. Yet at the probable distances of these nebulae, the individual stars should be shown on our photographs (unless they were all much fainter, intrinsically, than the sun). Twenty years hence, or even ten, there may be other chapters to add to our story, equal in interest to any that have so far been read.

The Heavens

The winter skies are now in their full glory. Orion dominates high in the southeast, with Taurus above and Sirius below. Procyon, Castor, Pollux and Regulus are all in the east—the last rising. The Great Bear ascends in the northeast; the Dragon swings low in the north, and Cassiopeia and Cepheus are sinking in the northwest. Above Cygnus, which is setting, Auriga and Perseus are visible. Andromeda, Aldebaran, Arcturus and Perseus in the west. The south-west, with the sparse stars of Eridanus and Cetus, is the only dull part of the sky.

The Planets

Mercury is an evening star all the month, but is so far south that he will be hard to see. The best time is about the 27th, when he is farthest from the sun, but even then he sets at 6 P. M.

Venus is also an evening star, but is further from the sun than Mercury and much easier to see. By the end of the month she remains in sight until 6.45.

Mars is a morning star in Virgo, rising at 3.30 A. M. in the middle of the month. On the first he is in conjunction with Saturn. The two planets are $1\frac{1}{2}^{\circ}$ apart and should present a pretty spectacle.

Jupiter, too, is a morning star, but much nearer the sun, and does not rise until nearly 6 A. M.

Uranus is in Aquarius, and is in quadrature east of the sun on the 6th, so that he can be observed all the evening. Neptune is in Leo, and rises about 9 P. M., in the middle of the month.

The moon is in her last quarter at 5 A. M. on the 1st, new at 8 P. M. on the 7th, in her first quarter at 10 P. M. on the 14th, full at 8 A. M. on the 22d, and in her last quarter again at 4 P. M. on the 30th. She is nearest the earth on the 6th, and farthest away on the 19th. During the month she passes near Saturn and Mars on the 4th, Jupiter on the 6th, Mercury on the 8th, Venus on the 9th, Uranus on the 14th, and Neptune again on the 26th.

At 5 54 P M on December 22nd the sun reaches his greatest southern declination, and enters the sign (though not the constellation) of Capricorn—and, in almanac language, "winter commences."

Princeton, N. J.

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1999

Doc. 2

At 9 1/2 o'clock: December 21

NIGHT SKY: DECEMBER AND JANUARY

the tides in our oceans. The outer edges of the lens-shaped mass. In this critical state, will be very sensitive to the smallest forces, and the outcome is that the outflow of matter, thrown off by the rapid rotation, will be in the form of a ring, or a series of equidistant "high-tide regions," so that it will stream, not in a sheet, but in two opposedly directed streams. The quantity of outflowing material is small, it will dissipate into space, if it is large, the mutual attraction of the particles will be sufficient to form a ring. It is, however, and it will form a long filament. There is, laterally, a strong tendency for such a filament to break up longitudinally into separate bits, just as a narrow jet of water (under quite different forces) breaks up into drops. The filament will break up into pieces, enough, will surround itself with a swarm of small convolutions arranged in streams along the bulk of the filaments from which they have been formed, and immediately in opposite points on the periphery of the stream.

Mathematics and the Nebulae

All this came as a definite, but in a sense unexpected, result of Jeans' mathematical reasoning. The resemblance of the resulting picture to that actually presented by the spiral nebulae is striking to a degree. Indeed,

Metering Water by the Wholesaler

VAST quantities of water are used by modern large hydroelectric power plants and the problem of metering this water, wherever this is required, is not such a simple matter as would at first thought appear. Several methods have been used but none has been at all satisfactory accurate when the work involves such large amounts of water. In factories, water is often consumed in tanks, made to run automatically when filled and spill the water into other receptacles. Soiling like this could possibly be used in such large power installations as, for instance, a certain one which uses 8500 cubic feet of water per second.

A new method of measuring water has been worked out by Professor C. M. Allen, of Worcester Polytechnic Institute and in practice has given remarkably accurate results. Common salt or sodium chloride increases the electric conductivity of water and this increase is in direct proportion to the amount of salt in solution. Brine is introduced into the pipeline at a considerable distance upstream and automatic timing devices record the changing conductivity of the brine as it passes given points at which electrolytic cells are inserted on opposite sides of the line. By dividing the volume of the pipe between the two points by the rate of passage, the rate of flow is arrived at. When tested against the weir and Venturi meter the new method is found to be very accurate. It proves superior to the method of measuring stream flow by the submerged float method and it is vastly better than the method which requires a section of the

Pulling Down a Church Steeple With a Motor Winch

A STRIKING example of the all-around usefulness of motor truck power was brought to light the other day in Jamestown, N. Y. The Presbyterian Church, one of the city's old landmarks, was being wrecked to make way for a new hotel. Huggins & Huggins, contractors for the job, secured a heavy cable from the top of the steeple to a motor truck which was mounted on a six-ton motor truck. On the first attempt to pull the steeple over the cable snapped. A new cable was attached. The winch operated by the truck engine wound slowly around. After straining and creaking for about three minutes, the steeple fell with a crash that could be heard for several blocks.

Small engines which, operated on the motor's driving power, are coming into widespread use as regular equipment on motor trucks. They are used for a surprising number of jobs from hauling trucks to hauling heavy boilers, from hoisting safes to wrecking buildings.

Chewing Up the Soil for Better Crops

ON the American market today there are several different manufactures of garden tractors and new from Eastland comes the description of one which differs radically from the American variety in that the soil is worked by a revolving member called a roller, instead of by the common toothed cultivating implement. The function of the roller is to chew up the soil mixing, lightening and pulverizing it thoroughly with the fertilizer that has already been spread over it.

The roller is driven by a two-cylinder, 10 to 16 horsepower engine. Lubrication is effected by a fuel pump on ball-bearings. Ignition is by high tension magnets. As in the case of the garden tractor the controls are laid to the handlebars. The motor is equipped with an



Roller in operation, with a diagram showing how its semi-circular wheels tear up the soil and leave it in a pulverized, aerated condition for planting

oil-cutter working on the lathe principle.

The bull wheel shaft is driven by a steel worm working on a phosphor-bronze worm wheel. The gears are of hardened nickel steel and run in an oil bath. Two speeds are provided for, the high speed corresponding to over 1½ miles per hour and the low speed being ¾ mile per hour with engine running at 1400 r.p.m. The bull wheels are 18 inches in diameter and the extreme width over all, when the regular 30-inch miller, is 54 inches.

The miller is driven by a level pin and cross wheel, enclosed in an extension of the power box which forms part of the body and thus runs in oil. The miller drive is independent of that of the bull wheels, permitting the miller to be moved about without stopping the revolving member or miller. The latter revolves at 150 r.p.m. carries twenty coil springs on whose extremities are fitted

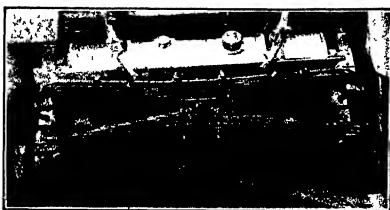


This church steeple is being pulled down by means of a motor-truck winch and heavy cable

twenty wedge-like links of steel. These are the tools which attack the soil. The total weight of the machine is 650 pounds and its height is 47 inches. One of the most satisfactory qualities of this self-cleaning device is its low speed. In order to do good work a garden tractor should not be geared so as to run as fast as three miles per hour—a speed at which the control of the tools is erratic, especially in rough or lumpy soil, therefore the low speed of the roller is an advantage.

Talc

TALC is by no means used only for the manufacture of talcum powder. Much of it is unsuitable for this purpose and is used in paint as a body material for filling paper, for use in the manufacture of rubber, and roofing. Much of the talc used comes from northern New York, Vermont and Virginia. The talc rock of New York is mined and brought to the mill where it is ground in ball mills until it will pass a 250-mesh sieve.



An odd spring suspension which takes the place of the usual shock arrangement and which is said to make for greater riding comfort

Taking the Roughness Out of Ruts

STILL another device for taking the roughness out of ruts now makes its appearance. This time it is in the form of a new type of automobile spring arrangement, worked out by L. H. Hummons of Los Angeles, Cal.

Constructed on the theory that absorbing weight in the shock is stilling comfort. Hummons, through the medium of rolling contact bearings and roller springs, has evolved a type of spring suspension which is shown in the accompanying illustration. The rear auxiliary roller spring here shown is composed of double transverse straight laminated springs secured at their centers with a roller bearing on coil spring joint between. Each end of the upper spring is connected to the axle frame by means of a roller bearing device. The lower springs are held in contact with the side springs by a roller pulley at the rear of a ball bearing between the springs making a trifling contact and allowing a greater range of spring or axle movement than with the usual construction.

The front coil spring is a quarter elliptic laminated spring attached to the rear end of the present semi-elliptic side spring by a connection enabling a horizontal roller bearing, the thick end being rigidly attached to the frame. The effect of this combination, according to the inventor, is the same as that of a long straight spring, since the arrangement allows double the ordinary range of spring movement. In this manner the roller bearing connection thus allows a greater range of spring movement than with the usual construction.

Asphaltic Types of Pavement

IN 20 leading cities of the United States there is enough pavement to cover an eighteen foot street that would reach the globe. This mileage by far exceeds that of every other country in the world. Of this total amount of pavement 78 per cent is of the type lighter than water-laid macadam, including about 22 per cent of bitack and 56 per cent of the smooth type of wood block, about 9 per cent of portland cement concrete, 2½ per cent of hot macadam and 54 per cent of asphaltic types.

The overwhelming predominance of the asphaltic types of pavement indicate the determination of modern cities to eliminate dust, noise, shock and interruption to traffic in street construction as far as possible.

The vast network of underground structures in American cities, including sewers, pipes and conduits, make it necessary to open the pavement at frequent intervals to obtain access to these underground services. The engineer must, therefore, provide a pavement which can be cut through without great trouble and expense, which can be readily repaired and which, after it has been repaired, blends with the old pavement.

For fast moving traffic the modern city pavement must be smooth and only to permit the rapid and comfortable movement of vehicles but to conserve motor fuel and tires. Only a slight saving in the operating cost per motor vehicle in the case of the smooth pavement results in an aggregate, when the vast number of motor cars is considered, to justify a considerable outlay to obtain this smoothness.

Import or the pounding of heavy motor truck wheels, has attracted the anxious attention of city highway engineers to an increasing degree during the past few years. A truck wheel with a drop of only one inch when in motion delivers a blow equivalent to at least six times the dead weight. City engineers therefore attach increasing importance to the elasticity and resiliency of pavement so as to take up the shock of impact.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News



An automatic coffee dripper

Drip Coffee by Machine

AN automatic coffee dripper to make a real 12 inch coffee that does away with the laborious process of pouring a teaspoon of water at a time into the pot has been invented by A. H. Lockett, wholesale machinery man of New Orleans. The construction and principle are shown in the picture. Cold water is placed in the reservoir at the right. The water passes through the pipe to the boiler, which is heated by electric stove. As the water boils it rises in the pipe on the other side and sprays out through the nozzle at the top up to the coffee in an ordinary drip coffee pot. A stop valve prevents the hot water from rising into the reservoir. A small pipe extending through the reservoir and into the large pipe leading to the heating chamber takes care of the expansion when the nozzle opening is held open enough to exhaust the full rush of boiling water and steam.

The Y-Square that Stays Put

ANEW combination drawing instrument uses a section cut for holding it to any surface. It is placed upon the cup is inflated by pushing on the knob of



Section-cut attachment for holding drawing instruments in the hand

the handle as illustrated. It will hold the instrument in the hand from ten to fifteen minutes. The cup can be turned out of the way when not in use. The instrument combines a protractor, ruler and square. All angles are quickly registered by operating the instrument around the pivot point which is the section cut. The holes in the rule are for chalk points and are placed every inch for describing circles.

A New Method for Determining the Rate of Sulfation of Storage Battery Plates

STORAGE batteries recently come into very extensive use particularly in connection with automobiles and anything dealing with the proper method of caring for such batteries is therefore of considerable general interest. The life and efficiency of storage batteries depend upon the purity of the materials used in constructing the plates and on the purity of the electrolyte. A little exact information is available on the effect of impurities in the solution which serves as the electrolyte and the methods usually employed for determining the effect of such impurities are time consuming and often inaccurate.

A new method has been devised by the Bureau of Standards for measuring the rate of sulfation of the plates resulting from local action. This method is rapid and accurate and is described in a paper appearing in this issue of the Scientific American. By this method a study has been made of the rate of sulfation of both positive and negative plates in solutions of varying concentration. The results are described in the paper. Paper No. 225 of the Bureau of Standards which may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C. at 5 cents a copy. This paper covers the first part in a more extended investigation of the effect of impurities.

Discussion of Logging and Safety Code

The Bureau of Standards has prepared a discussion of the recently adopted safety code governing logging and sawmill operations. This discussion is intended to explain why certain provisions are included and also in some instances to give further details concerning methods of safe operation. It will be recognized that this is in line with the discussions published on the National Electrical Safety Code known as hand book No. 4 of the Bureau of Standards and the discussion of the Head and Eye Book issued by the Bureau of Standards. The discussion will be illustrated by photographs taken in the field by the Bureau's engineers by the United States Forest Service and various State commissions.

One interesting item in this discussion is the description of the Y-shaped method of felling trees. This was worked out by the Southern Pine Association for the purpose of preventing "kick backs" of the butt of the log as the tree fell. Not only was this method successful in preventing such "kick backs" but when put in practice it was found that it gave larger yields of sound timber than the old method of making a horizontal cut. A reproduction of the paper published by the Southern Pine Association is given in connection with the description of this method.

Micrometer and Snap Gage in One

AN automatic spring driven measuring machine, controlled by contact with the object being measured, combines the functions of the hand micrometer and the limit snap gage. It is an automatic micrometer having an operating range of 150 inches, an adjustable range of one-half inch and an interchangeable tolerance segment on the index arm. It is automatically centered and squared on the work. The micrometer spindle is automatically retracted, automatically set to a definite pressure and automatically locked to retain the reading as the instrument is withdrawn. It follows up measurements and reductions and is set back by hand to receive the next piece.

There is no need of to be remembered, drawing size to be subtracted or calculation to be made and no numerical tolerances to be considered. For production use it is adjusted to read zero at the finish size. It then reads directly on the dial the amount over or under the size to be reduced. The reading is automatically retained and the machine tool may be accurately set for the next reduction or the finish cut. There is no guesswork of time lost in working down to size. The operator gives all his undivided attention to the efficient reduction of the work within the allowable precision as graphically shown on the tolerance plate.

A measurement takes only two seconds with one hand. It can be taken in any position from any direction as there is no mechanism to be manipulated and the dial need not be in view. The dial is large, the scale open, the lines and figures distinct and the zero in the same central position for all adjustments.

It is always adjusted and used to the index line representing the exactly correct size of the product. The user aims at the correct size and produces a constantly correct average size, while the tolerance is maintained. The occasional extreme deviation covered in the interest of rapid and cheap production.

Method for Making the Interior of Automobiles More Comfortable in Hot Weather

ATTENTION has been called previously to a simple means for decreasing the heat radiated through a tent or other light covering which is exposed to the sun. By coating the under side of the tent cloth with aluminum paint the heat radiated from the under side is reduced by 80 per cent. Painting the outside with aluminum paint was found to be slightly less efficient; the heat radiated from the under side being reduced only about 50 per cent.

Coverings of conveyances, such as, for example, the tops of automobiles, awnings, etc., consist of cloth, the outside of which is often painted with a black composition which absorbs perhaps 80 per cent of the sun's rays. Practically half of this is radiated from the under side of the cloth. There are in progress at the Bureau of Standards which show that a coating of aluminum paint applied either to the outside or inside of such tent coverings will reduce the heat intensity of the heat radiated from the under side into the interior of the conveyance.



The automatic micrometer, that discharges also the functions of a limit snap gage

The Individual Radiator

INDIVIDUAL radiators in heating a single room that has no connection with a central heating plant for the entire house, it has been necessary to use a stove of some sort, radiating its heat directly into the atmosphere of the room. Whether the stove be a wood, coal or oil burner, whether it be used with or without a pan of water to maintain the proper degree of moisture content in the room, there are serious drawbacks to this procedure. These evils to be avoided in the individual radiator which we illustrate herewith. The hottest tank of gasoline feeds the two burners in much the same way as with the conventional gas or oil burner. These burners heat the air in the smaller cylindrical chambers above them and the hot air heats water in the larger cylindrical compartments just below the radiator. A thermosiphonic circulation is set up through the radiator, and the latter radiates heat to the room just as does the radiator of the conventional hot water heating system. The radiator tubes are



The individual radiator for rooms that have no connection with a central heating system



Clearing the kitchen drain without needing for the plumber

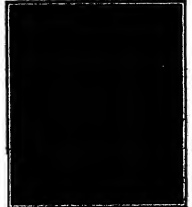
of copper. Fuel and water for a week's operation. It is cleaned, are supplied at a single charging of the tanks. The apparatus is recommended, and is obviously of value, for isolated rooms and unheated apartments.

Accuracy of Analytical Weights

AN instance of sustained accuracy in the weights which are now being submitted to the Bureau of Standards for test was noticed during the past month. In a shipment of nine sets, containing a total of 216 weights, all were within the required accuracy. Only once before has a larger number of sets been submitted without some of the weights having scores greater than the prescribed tolerance. The fact that such shipments are now received, even if only occasionally, is an encouraging indication of the good work done by some American makers. It need not be said that such sustained accuracy would have been entirely out of the question as recently as two years ago.

The Renewable Eraser

THE consumption of circular erasers in the ordinary office is very heavy, and these handy little correctors constitute no small percentage of the stationery bill. The metal holder (see illustration) (if the brass type be used) cost the manufacturer more than the abrasive material section, and this, in the long run, a Pittsburgh concern has put out a model designed to save these portions of the eraser ensemble from the waste basket. A new eraser goes into the holder, just as a new pen goes in the old penholder. All that is necessary is to loosen the screw, make the substitution and replace the screw. We don't throw away penholders or drill handles; why throw away eraser handles?



The plan that uses the eraser again as the exhaust gases of the propelling engine, to disrupt the soil

The Home Plumber

IF the best regulated families, outside grounds and grass get into the drain of the kitchen sink and check or stop entirely the flow of water. The handy little aid to good housekeeping shown in the accompanying photograph steals a few plums from the plumber and enables the mistress of the house to clear out the pipes herself. If it is used, as shown, with a little water in the basin of the sink it works through hydraulic pressure, and is powerful enough to force down into the trap almost any accumulation that may be in the pipe.

Medicine to Breathe

PHYSICIANS often prescribe the inhaling of medicated vapors in treating coughs and other disturbances of the chest cavity, the nose and the throat. But a proper and continuous supply of the vapor, of uniform concentration, has not been easy to obtain. The cough kettle, steam inhalers and inhalers of forced have been but half-way measures, lacking the proper efficiency.

A very clever invention has, according to the claims made for it, solved the problem. The idea is that of the old-fashioned lamp wick, but the wick does not carry the fuel. It carries, instead, the medicated liquid which it is desired to vaporize for the patient to breathe. It draws this from a reservoir, just as the lamp wick draws its oil. The wick in the radiator, as the apparatus is called, however, presents the surface of an electric light globe of a type whose luminous efficiency is rather low, and which, therefore, develops more heat than should be desirable if it were being used as a heater. With the wick carrying the medicated liquid in minute but uniform quantities to the large, evenly heated surface of the radiator, the full vapors at once and at a constant rate, and the patient is assured of exactly the atmosphere which is now prescribed for him. A larger and more elaborate model than the original one just de-



Don't throw away the handle of the

scribed passes the medicated vapor through a water-cooled frame cylinder, reaching the patient only after this filtering, and giving double assurance of a water vapor continuously and evenly medicated.

The Exploding Plow

SOMETHING new in plows is being marketed, based upon patents issued to Herbert Knight of New York. Instead of simply turning the ground over, the new implement shatters it, the pulverizing being accomplished by a series of explosions that take place below the surface. The plow is propelled by a gasoline motor, the exhaust gases from which are conveyed through a suitable pipe into hollow cultivator teeth which extend into the soil. The lower ends of these teeth have suitable openings, through which the gases discharge with detonating force. The ground is thoroughly broken, the weeds torn out, and the earth left in a fluffy and highly aerated state. The detonating gases are mainly carbon dioxide, water vapor, oxygen and nitrogen, all beneficial to plant growth. The force of the explosions destroys fungi, undesirable insects, eggs and larvae.

Conveniences for the Smoker

A VERY complete and handy match box holder has recently been invented by E. R. Gannon of Columbus, Ohio. It is manufactured in two sizes, the smaller for safety matches and the larger, as illustrated, for double-tip matches. Both show have fireproof receptacles on inside flaps for the receipt of burnt matches, as well as fireproof ash trays. Both are adapted for mounting upon any vertical, horizontal or inclined surface, or to set loosely upon a horizontal surface. The top of the cigarette case or container. The small size is admirably suited for mounting upon the instrument board or windshield of an automobile. An empty box can be removed from the holder and a full one substituted in less time than it takes to tell about it. The match box itself is held securely in the most convenient half-open position, and does not have to be broken out at one end and subjected to the removal of matches. Both holders are made of sheet metal.



The electric vaporizer for medicated vapors

Methods of Measuring the Properties of Electrical Insulating Materials

SCIENTIFIC Paper No. 471 of the Bureau of Standards which can be obtained from the Superintendent of Documents, U. S. Government Printing Office, Wash. D. C. at 15 cents a copy, describes methods of measuring the properties of electrical insulating materials. This paper gives a series of electrical, thermal, chemical and mechanical test methods which have been found useful in the study of solid electrical insulating materials. The several tests described are those used in obtaining the data previously reported in Technologic Paper No. 216 of the Bureau of Standards entitled "Properties of Electrical Insulating Materials of the Laminated Phenol-Methylene Type." The several test methods described are radio-frequency phase difference or power loss, dielectric constant and dissipation factor, direct-current surface resistivity and volume resistivity, tensile strength, modulus of elasticity (tensile), proportional limit, modulus of rupture, modulus of elasticity (transverse), brittleness hardness, resistance to impact, permanent distortion, density, moisture absorption, machining qualities, thermal expansion, and the effects of heat, acid and alkali.

The methods and apparatus are described in some detail. First, so that the data in Technologic Paper No. 216 will be definite and be capable of being correctly compared with other data, second, so that any of the tests may be reproduced by others.

Tests of Radio Receiving Sets

THE results of tests of radio receiving sets by the Bureau of Standards are given in a series of Letter Circulars, the first one of which (No. 90) was issued a few weeks ago. This paper deals with tests of electronic tube sets. The second circular of this series (No. 92) is now ready for distribution and gives the results of tests on crystal detector sets.

It is believed that the methods followed and the examples given in these reports will be of assistance to manufac-



Fresh and burnt matches and ashes are all taken care of by this holder

turers in the development of methods of testing besides aiding them to properly describe and improve their products. The particular receiving sets are referred to by arbitrary reference numbers rather than by manufacturer's name and type and model numbers. As these circulars are available only in mimeographed form, the supply is limited but copies may be obtained by those directly concerned with the testing of receiving sets by addressing request to the Bureau of Standards.

An Indoor Draft for the Kitchen Range

WITH the appearance of the accompanying drawing one of the ordinary stove holes in the top of the kitchen range may be used to secure an improved draft and a hotter fire. The "hot blast" device, as the inventor calls it, takes the place of the stove lid, and he emphasizes that it doesn't occupy any more space than a cooking kettle, and is more economical.

The idea of the hot blast is to have an extremely hot gas jet, immediately below the discharge point of the apparatus. The fashion in which it achieves this is self-explanatory. An additional function may be got from it when slack or provided coal is burned. The cylinder of the blast outfit, around the draft tube, may be filled with such material and will act as an automatic auxiliary feeder, having a continual supply of highly combustible fuel at the hot spot of the fire. This does not, of course, replace hand stoking entirely, it is simply an auxiliary arrangement, looking toward making the hot fuel point of the fire even hotter than it would be possible to have it with the blast alone.



The hot blast device for making the kitchen fire hotter



The driving light that can be instantly thrown, and can, upon any point of the road or the surrounding country

The Light that Shines Where It Is Needed

FOR open or closed cars, the driving light which we illustrate gives a versatility of performance and an ease of operation which, the manufacturer says, can only be appreciated through actual use. The light is instantly rotatable to any point on a sphere, and will remain fixed in any position on the railroad road. The means for this moving it is the control handle which is seen projecting from the frame of the car toward the driver. The slightest touch upon this handle changes the light from its normal position of straight ahead, to the ditch giving perfect illumination for the driver at the point where he needs it most in passing, while at the same time extending to the approaching car, absolute freedom from glare. Two electric switches at the base of the control handle, in such a position that the thumb rests naturally upon it in grasping the handle, permitting a quickness of turning on and off never before attained. It gives a combination of the spotlight and the driving light which should be of the greatest value to all who are obliged to drive extensively at night.

Smooth Starting for Steam Trains

DETAILED description of the improvement in railroad couplings patented by Mr. R. W. Brown of Lancaster, Pa., would be out of place were it a railroad magazine, but a statement of what it does and its general use, how it does it should be of general interest. Everybody who ever rides on a steam train knows how the cars bump and jerk in starting, while the slack in the couplings is being taken up, and how the entire train heaves and buckles as each coupling straightens out, taking up its load, and gives the first jerk to the car behind it. Mr. Brown would equip our cars with central longitudinal gliders or frames, running from coupler to

coupler. These frames would have a certain amount of play under the car, for which the inventor has made ingenious provision. When the engine gives its first forward impulse, the first coupling would go with it, as always, but instead of bringing the first car along, this would merely move the sliding glider-frame forward sufficiently to take up the slack of the second coupling. With this coupling in play, the same thing would happen under the next car, and the rest, and the rest, and none of the cars would tend to move forward at all until all the couplings were taut. Then the rear car would act the pull, would have no car behind it to pull forward, and would start to roll forward, bringing the entire train into motion without jars or jerks.

A Novel Demonstration

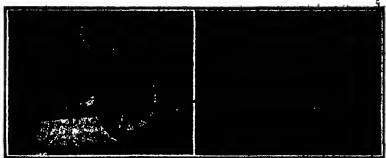
AN automobila's lubrication, in some measure at least, depends upon gravity to make the oil flow over the lubricated surfaces, and this is true of cars having the most elaborate forced-oiling in only less measure than of those relying upon the simple splash, so when a prospective purchaser lives in mountainous country, it is a pertinent question for him to ask what effect unusual running on heavy grades is going



To prove that the oiling system would function under the severest handicaps, this demonstration car was run under its own power in the condition shown

to have on the lubrication system of his car.

A San Francisco agent for one of the popular lighter sizes recently staged a very clever demonstration of the proposed invention on a hillside of the city ground. As our illustration shows, he built a false bottom under the front of his car, of such height as to tilt the chassis to an angle of 32 degrees. With a steering gear that had been sufficiently loosened with to make the feet possible, he drove this fearfully up-lifted car for many days and many miles through the streets of San Francisco and Oakland, always under its own power. The complete failure of the oiling system to give the slightest trouble under this severe test is offered as proof positive that the car will get oil wherever it can go in California's mountains.



The automatic feeder for cars and trucks, in driving and dropped positions

An Automatic Safety Feeder

IT has long been contended that the high total of deaths resulting from persons being struck by automobiles and trucks could be materially decreased by the invention of some sort of feeder which would keep the victim of the accident from rolling under the wheels of the vehicle. In nearly every instance where death has occurred as a result of accidents of this nature it has been due to the fact that the person struck has been run over by the wheels before the vehicle could be brought to a stop.

A countless number of safety devices has been developed that claimed to work

with white paint, glass enamel, aluminum paint, etc. These tests are of interest in connection with the question of heat radiated from the under side of roofing material, etc., when exposed to the sun. Data were given showing that a coating of aluminum paint entitled only 27 to 30 per cent as much as white paint, glass enamel, or other nonmetallic surfaces.

The application of this information to the painting of radiators for heating houses is obvious. But the gain in heating, by covering the surface with a non-metallic paint, is not two to three times that of the aluminum paint, as might be inferred from the above-mentioned data. This is owing to the fact that an ordinary steam radiator is cellular in structure, while facilities having of the air by conduction and convection. The heat radiated from the sides is relatively of secondary importance.

Previous publications on this subject (Alum., *Electrician*, 57, p. 1616, June 22, 1911, and *Jour. Am. Soc. Heating and Ventil. Eng.*, 28, p. 305, 1902) indicate that a radiator coated with aluminum paint emits only about 50 per cent as much as a radiator which is enameled or covered with a nonmetallic paint.

In other words, we may expect a gain of 15 to 20 per cent in heat dissipation by using a nonmetallic covering on ordinary house radiators. This is worth considering. The nonmetallic coating can be painted over the aluminum paint (if the radiator happens to have a coat of aluminum) which is a good conductor of heat and hence does not impede thermal conduction through the walls of the radiator.

The Talking Glove

THE curious glove which we illustrate is herewith has two uses. The letters are marked upon it in the positions of one of the standard alphabets wherever deaf-mute people are among themselves with such incredible speed. One learning the alphabet and its use may wear the glove for signals until he acquires facility; and one who does not

to this end. A recent one is of unusually simple construction, consisting of a bumper, a horizontal trip bar and an automatic feeder. The trip bar is located on each of two in front of the fender when driving, and the instant the person is struck it releases the feeder, which drops to the ground and, by pushing plus along in front of him, prevents the person's body crushed beneath the wheels. It is said to be impossible for the victim to get beneath the wheels of the vehicle, and the most extensive tests have served to bear out this contention, the feeder never failing to operate.

When a body is struck the feeder automatically releases and drops to the ground, thus pushing the body ahead of the truck and making it impossible for it to get beneath the wheels of the vehicle. The driver has his hands free to stop the vehicle, is not required to lift a finger to operate the feeder and need pay no attention to it whatever, because, as the name implies, it is actually automatic in its operation.

To the thousands of car and truck drivers throughout the country who do large amount of driving and who are always a bit nervous as to the possibility of accidentally running into a pedestrian, this invention should be very attractive.

A Means for Increasing the Efficiency of Railroads

IN the last issue of the *SCIENTIFIC AMERICAN*, mention was made of tests in progress at the Bureau of Standards on the suitability of sheet iron covered



Looking down upon the running gear of a railroad coach, equipped with the apparatus that allows the couplings of successive cars to play around one another until the slack is taken up, so that the train may start without jerking

For learning the deaf-mute alphabet, the glove is used. It is made of leather and is very durable.



Portable hand saw specifically designed to work with either wood or metal

expect to learn it, but who must talk with a guide-and-dumb person, may use it as a pest for his own speech and a means of translation of what is said to him. The letters are arranged, it will be noted, in a manner not entirely dissimilar to the universal traveling key-board.

A Simple Luggage Carrier

AN unusually effective luggage carrier has just been put out from North Tonawanda, N. Y. As our photograph indicates, without making the modes operated exactly clear, the new carrier provides means for strapping with the utmost security to the running board anything of such size that the running board will carry it. The means of accomplishing this consists in the main of a metal strip, extending across the running board from the inside to the outside edge. At the inside edge it is securely bolted to the running board by means of a long bolt and a wing-nut. At the outside, the weight of the luggage which it carries holds it flat. All along this strip there are oblong holes, into any of which the outer strap wraps up a snaffle hook. The inner strap snaps snuggly into the upper end of the bolt member. The two straps are then brought around over the baggage, drawn as tight as may be and locked together. Photographs are shown of a full-sized steamer trunk carried in this way for 8,000 miles, a suitcase carried 6,000 miles on end, to leave the door closed, the outfit of baggage and camp equipment in nine pieces carried over 8,000 miles. In the latter case, four of the units were employed, with single pieces of baggage two men always plenty. In any case as many may be mounted as the exigencies of the situation demand, and the baggage is carried with complete security because, in the words of the manufacturer, it becomes for the time part of the car.

Each Coil a New Fuse

SOMETHING new in the way of re-servable fuses has just been put out, and is illustrated herewith. The six coils of wire in the device represent six fuses, any one of which is immediately ready for connecting to the terminal after it has been extinguished. These coils



The newest re-servable fuse outfit.

are of standard size composition. We show the fuse with one coil straitened out and attached to the binding post, and the others waiting to be used in turn.

The All-Around Band Saw

AMONG the season's novelties in the tool industry is a portable band saw for cutting wood and metal, put out by a Wisconsin manufacturer. It is claimed to be the only portable metal-cutting band saw on the market, and the only one that is especially designed for cutting both wood and metal. The illustration gives a good idea of the general character of this new. Special features worthy of mention include ball bearings for the saw wheels, with upper wheel adjustable by sensitive hand-screw to insure perfect alignment. Tension on the saw-blade is controlled by another hand-screw, which works against a spring in such a way as to obtain uniform and cushioned tension. Incidentally, when chips and blocks fall between the saw and the wheel, this spring flares out they pass harmlessly around the wheel, without breaking the saw blade. The very efficient guard members swing outward on a hinge, opening the wheels and the blade to the work, and closing and adjustment. For shaping jobs of all sorts in wood, steel, iron, aluminum, brass, flux and hard rubber, it makes room for the machine without reserve.

Spring Hangers That Are Different

ONE of the points where the Linde company has made a mark above all other verbal and operating—is the front spring shackles. It almost seems as though the average driver had no realization at all of the fact that the weight of the entire front half of his car is suspended from the springs by these four little members. But whether he be inclined to do his duty by the shackles or to shirk it, he ought to find greater riding comfort with the suspension illustrated. This, it will be observed, substitutes for the single pair of shackles at each end of the spring a duplex effort, and it has a little satisfactory spring between the two points at



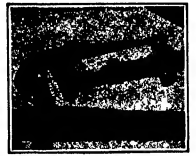
Making the baggage part of the car which suspension is effected. The weight is shared by a vastly better cushioning; and it certainly looks plausible.

New Use for Moose Traps

ACCORDING to the United States Department of Agriculture, the Federal trap has a new Government job. Finding English sparrows, which have been committing serious depredations on the immature corn and mango beans growing in the experimental plots of the Federal experiment station at Hottel, Ill., well, too wary to eat poisoned grain, the moose trap was called into service. In the corn plots, the traps were wired to party-station cars. For bait a soft keratin is used. When the bird attempts to eat the innocent-looking bait, the trigger is released and the pitfall caught by the bird or mouse. Death is instantaneous. For the mango beans, the traps are also baited with soft corn and laid on the ground near the plants.

The Latest Stream-Lined Car

FROM Berlin, the home of the stream-lined automobile, there comes forth every now and then a brand new shape in which this idea is worked out in a different fashion. The very latest example looks a good deal like the domicile of the old woman who lived in a shoe, until one gets the proper mental and optical slant upon it to realize that it is really an automobile. In keeping with modern doctrine that the stream lining of the rear is of more vital importance than that of the front, the long wedge-shaped profile presented by this car to the stern is the most conspicuously blunt. The wheels seem to be of the conventional type pattern, apparently with no attempt to stream line their profile, which might seem a fatal omission. Our photographer states as, however, that the wind vehicle has great speed—and, of course, that it "was taken years to perfect."



A novel spring suspension for the front system of the Linde

How Strong Are Blow-Down Walls?

IN a series of tests made by the Bureau of Standards in a 10,000-pound hydraulic testing machine, and described in Technological Paper No. 298 of that bureau, walls made of common firebrick twelve inches long, twelve inches wide and either six, eight or twelve inches thick were tested to the point of failure. These tiles were first tested individually and their strength was found to be much greater than that of those usually used in building construction. Their design was such that all the net area was in bearing when carefully set on end in the wall. Owing to the fact that the walls were very carefully set by an experienced mason they are considered to have been stronger than those usually used in buildings.

Of the thirty-two walls which were tested about half were built with the cells of the tile vertical and the other half with them horizontal. A few walls of each construction were twisted under an eccentric load two inches off center. It was found that considerable difference in the strength of the tile did not have an appreciable effect on the strength of the walls. No relation was found between the ultimate strength and the load at first crack. Walls having the cells of the tile vertical held on the average more than twice the strength of those having the cells horizontal. Walls twisted under an eccentricity of two inches had about one-half the strength of similar walls axially loaded. Apparently this ratio is independent of the thickness of the wall.

An Electrically Lighted Gas Furnace in the Floor

AN electrically lighted, fully vented gas floor-furnace is now offered, in which the entire control and lighting apparatus act as one. When the gas is turned on, a pilot light (of low tension) is formed which gives a spark and is fed into the plug. Lighting is thus positive and instant, without the use of pilot or matches. This should not be confused with the ordinary "electric



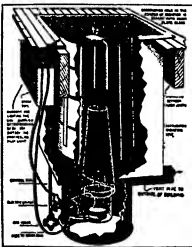
Stream-lined in its latest form—not a shoe, an automobile

pilot button control" which consists of a magnet valve and requires a pilot light to be burning constantly.

The electric current is supplied by a four-cell dry battery and a standard spark coil. The spark plug is in a cast iron chamber and does not come in contact with the flame. If, as desired, the battery may be eliminated by connecting the spark coil to a belting-tranformer of the proper size.

This gas furnace has many safety features. It has no dangerous pilot light, and the products of combustion are all safely withdrawn from the room air, being drawn off through a concealed vent pipe. There is no danger from explosion, as the construction is such that it may be deliberately filled with gas and then ignited without harm or danger. This important feature is due to the entirely open design of base of the combustion chamber. The flame cannot be blown out by a down draught or back draught in the flue, as it burns within a cone-shaped combustion chamber and is, therefore, isolated from any side draught. The effects of a back draught are cured by the small safety vent holes in the lower portion, just below the flue outlet. In event of back draught the "dead air seal" drops slightly, thus uncovering the safety vent holes and allowing the backed up flue gas to escape through them without smothering the flame. Should the axle be turned on deliberately without lighting it, there is no danger of its entering the room. There is no danger of fire, the box, insulated with asbestos, may be placed snug against the wood joists without the least danger—the box contains coal on account of the cold air intake space entirely surrounding the hot radiator. The furnace is so simple and fool proof that a child can safely operate it.

The furnace is unusually economical in the operation—high efficiency being obtained by the method of passing the hot gases through a double ribbed corrugation instead of the usual tubes.



The fool-proof gas furnace to be installed beneath the floor.

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGE, M. E. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles.



New electric truck chassis, showing accessible carrying boxes for batteries, suspended on their own springs to reduce shock.

Electric Truck with Novel Battery Suspension

AMONG the woman's new offerings is an electric motor truck in which the construction has no numerous weak points simplified to promote ease of operation and accessibility of all the important units. The chassis is designed as a complete unit, with no part of it depending on the body. The dash, fenders, wheels, etc., are included in the chassis package. The electric driving motor is mounted under the seat. It is hung in a heavy cross member, which also serves as a support for the front end of the battery. The motor is connected to the rear axle through a three-joint power-shaft unit, which is supported in the center by a self-aligning bearing.

The outstanding feature of the new truck is the battery suspension. A sliding tray is provided by means of which the battery trays are mounted in a slide master tray, which is an roller in the chassis, and can be saved, without auxiliary apparatus, into a position where all of the cells of the battery can be reached for fluiding or other attention. It is unnecessary to break any electrical connections to do this work, and the door of the battery box is not a hindrance for the sliding tray. Means are provided for stopping the tray at the end of its travel, but these stops are easily detached when it is necessary to remove the entire tray from the truck. Therefore, for complete replacement purposes, the battery can be removed easily in two sections and a fresh battery substituted. The trays and compartments will accommodate regular and overseas batteries for the various models. Any standard battery can be installed.

It is difficult to design a structure successfully to carry such a highly concentrated load as a battery. For convenience in manipulation and to make all of the car platform space available for payload, this mass should be hung beneath the frame. Such a construction brings the center of gravity of the battery close to the ground. With this relationship, it is not possible for the conventional springs to function properly in cushioning the battery and frame against shocks, and the normal accelerations and vibrations from a rough road set up heavy stresses, both in the battery and in its supporting frame. These stresses are multiplied many times when the truck backs up against a platform or curb. In the new electric this problem is relieved by swinging the battery directly

in links to permit movement in the direction of the motion of the car, and with this movement opposed by springs, quite distinct from the chassis springs. Construction is obtained which eliminates shocks due to this unsprung weight.

The new electric truck is unusual in other respects, not the least of which is the fact that it is put out by a concern that has for years manufactured gasoline trucks. The long-carried elements of the chassis are of the same design and construction which have been tested by years of successful operation of thousands of gasoline-driven vehicles. It is possible to install a body with the platform close to the ground, so that the load can be handled easily. The chassis is designed as a complete unit, with no part of it depending on the body. The chassis is designed as a complete unit, with no part of it depending on the body. The chassis is designed as a complete unit, with no part of it depending on the body.

hand brake for emergencies and for holding the truck when at rest. It is also possible to reverse the motor for emergency braking—a feature unique to the electric truck.

A Self-Contained Kerosene Carburetor

THE fuel situation is more acute in England than it is in this country, as it is necessary to import the greater part of the fuel used in automobiles because there are no local sources of supply, if one is to except the shale derivatives and benzol, neither of which is produced in sufficient quantities to supply even a small part of the demand. For that reason, English truck designers continue their experiments with devices intended to burn low grade fuels corresponding to what is sold in this country as kerosene.

A kerosene vaporizer operating on the partial combustion principle is used on certain trucks and was recently illustrated and described in our English contemporary, *Engineering*. The device is somewhat smaller than other kerosene carburetors and is self-contained, that is, it does not require so-called hot-spots or exhaust-heated manifolds. The kerosene tank is connected to the carburetor inlet, and is controlled by an ordinary

carburetor float. From the float chamber the fuel travels into a passage in the body of the main casting, to which are connected a main jet and an auxiliary jet. The main jet terminates just above the level at which the float valve maintains the oil, but the fluid rises through the auxiliary jet into the bottom of a small secondary chamber. Fitting into the sides of this chamber is a casting, the bottom of which is pierced with a number of holes, each of which is filled by an asbestos wick. The lower ends of these wicks dip into the kerosene in the secondary chamber.

To start the engine from the dead cold condition, the carburetor cover is removed, by loosening the wing-nut which holds it, so that air has free access to the inside of the wick casing. A high tension spark is then passed from the spark plug to a piece of metal surrounding the wick directly beneath the plug. This ignites the wicks, which are allowed to burn for a minute or so, to warm the casting. The cover is then replaced and the engine is ready to be started. The spark is again switched on and the engine cranked round. The operation of cranking draws air through a passage in the carburetor, which has this air is separated into two portions. One passes directly down

through the carburetor pipe and upward past the end of the main fuel jet. This is the main vaporizing air which draws the kerosene out of the jet and carries it upward in the form of mixed vapor and spray.

The other portion of the air is led to an annular space surrounding the wick casing and passes into the interior of this casing through the numerous small holes drilled through its walls. The presence of this air keeps the wicks burning after they have been lighted by the spark. A small part of the heated products of combustion passes upward, mixing with the pure incoming air to raise its temperature. The major part, however, passes out at a very high temperature, heats the kerosene spray as it comes from the jet and completes its vaporization.

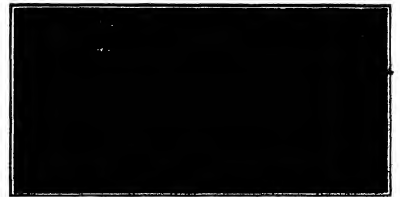
A valve below the jet admits the mix-

ture and forces the vapor into contact with the walls at a point where it is maintained at a high temperature by the hot gas or flame surrounding them. The air and the kerosene vapor, required for combustion, are controlled by aspirable butterfly valves, so connected that a richer mixture is automatically provided when the engine is "flogging," and the mixture strength may also be increased above the normal under overload conditions.

It is claimed that the engine can be started within a minute or so from cold, without the use of gasoline or any means of auxiliary heating. As soon as the engine is firing, the spark in the vaporizer is switched off, as the passage of air over the wicks is then sufficient to keep them alight. Should they be blown out by a backfire, or become extinguished from any other cause, they can be instantly reignited by switching on the carburetor spark momentarily. When the engine has been running long enough to heat the water in the radiator appreciably, it may be stopped and restarted by ordinary cranking after an interval of about a minute or so from cooling down, without removing the cover of the carburetor.

Crawler-Traction Member for Wheeled Tractor

JUST as a wheel is an automotive product so it is marked in sufficient quantities so that its distribution is general, then other manufacturers devise attachments to increase the usefulness of the machine or to adapt it for certain work that it would not perform so creditably by itself. An attachment that is said to double the tractive pull of a well known light tractor of the wheeled type that is made in large quantities, operates on the "crawler" principle and is designed to replace the traction wheels or directly supplied by the manufacturer. Needless to say, these traction members provide means for ground contact (the wheels and can be used in soft and boggy soil where wheels, even with lugs and extension rims, would be at marked disadvantage). Two widths of track are available, although, for use on hard ground, and twelve-inch for soft places where more ground support is needed. The widest type has pressed steel grooved wheels to maintain contact with the ground. It is stated that the attachment can be installed in place of the wheels in about an hour.



Showing an asphalt street with a wheeled tractor, equipped with special crawler-traction member.

Recently Patented Inventions

Brief Descriptions of Newly Invented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

PROPULSION MEANS FOR FLYING MACHINES.—A. B. HART, Pat. 1,741,121, N. D. The object of the invention is to provide propulsion means which is adapted to propel the flying machine either forwardly or upwardly, the direction of travel being thus readily varied by varying the angle of the action which is readily controllable. An other object is to provide propelling means which may be utilized to retard the descent of the plane.

AIRPLANE.—J. R. BART, Pat. 1,741,122, Territory of Hawaii. The invention relates to an airplane that is supported in the air and uses the water as a means of propulsion. The essential part of the invention is the propeller which is not arranged to mix on the air for a reacting mass, its purpose being to engage the water, and it is secured in such a manner that the tips of the blades engage the water surface as a reacting mass. (See Fig. 2.)

Pertaining to Apparel

GARMENT.—A. SILVERMAN, ST. Paul, Minn., New York, N. Y. This invention relates to a detachable vest for coats. An object resides in the provision of a vest which can be applied to a coat with a minimum disturbance of the construction of the coat proper, so that the fit of the coat is in no way affected. A further object resides in the provision of means whereby the ends of the vest, when not in use, may be slipped in back of the coat facing and fastened therein, so as to have the appearance of an ordinary coat lining.

BATH RETAINING DEVICE.—O. H. LESCHKE, C/O REYNOLDS, 270 Broadway, New York, N. Y. The primary object of the invention is to provide a device for retaining a hat or other head wear securely in place and against accidental displacement from the head, the device affords ready means for detachably securing the same with a hat, cap, or head wear, and means for adjustment in order that the device may be applicable to heads of various sizes.

Electrical Devices

RENEWABLE PRIMARY DRY-CELL BATTERY.—W. B. LUK, C/O Electric Device Co., Kent, Ohio. The object of the invention is to provide a renewable dry-cell battery adapted to enable the user to readily disassemble the parts, renew the combined depolarizer and contact or the zinc anode and reassemble the parts to start. An effective battery the same as originally placed on the market, the battery is immediately serviceable for use in self-contained electric lamps.

ELECTRIC CONTROLLING DEVICE.—W. W. LUDWIG, EBE No. Main St., Erie, Pa. This invention has for its object to provide an electric controlling device for typewriting and other machines, comprising a keyboard, and arranged to permit an operator to selectively actuate the different mechanisms of the machine without requiring much shifting on the operator's part.

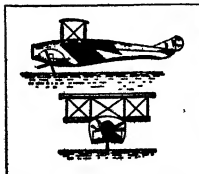


Fig. 1. A. B. Hart's sliding plane, showing the spring mechanism.

3.—WHAT MAY BE PATENTED?

UNDER the constitution of the United States the Congress has been given power to promote the progress of science and the useful arts by granting for limited periods to inventors the exclusive right to their discoveries. Accordingly, under our statute any person who has invented or discovered any new and useful art, machine, manufacture, or composition of matter may be granted a patent by the Secretary of the Interior, and the term is not used in its generic or broader sense. Likewise the word "art" is given a more limited meaning, and in the sense of the patent law it signifies a process. In all probability the great majority of patents granted are for machines or other mechanical structures. Almost any machine when resolved into its component parts comprises a combination of old elements. If these old elements are combined in a new way or so as to produce a new or better result, the combination constitutes patentable novelty. Just what is a "manufacture" in the sense of the patent law is difficult to define. Broadly speaking, whatever is made by the hand of man and is not a machine, nor a composition of matter, nor a device, is a manufacture. The term "composition of matter" may, according to Walker, be said to cover all combinations of two or more substances and in the sense of the patent law it signifies whether they be results of chemical union or of mechanical mixture, or whether they be gases, fluids, powders, or solids. Not only for so-called "mechanical inventions" but also for designs may patents be granted under our law and the statute provides that any person who has invented any new, original and ornamental design for an article of manufacture may obtain a monopoly thereof for a limited period. Design patents afford protection for the aesthetic creations of the inventive mind and include a vast array of subjects. The period of the design patent as distinguished from that of the machine patent, which is seventeen years, may be three and one-half, seven or fourteen years.

Another object is to permit the use of the controlling device without the use of the usual keyboard, and to permit the removal of the device whenever it is desired to operate the machine by the use of the keyboard.

SOCKET COVER.—M. BERMAN, C/O Reuben Mott, 1000 E. 10th St., Brooklyn, N. Y. The invention relates to a socket cover for electric light fixtures, its object being to provide a socket cover so constructed that it may be adapted for use either with a ball or spherical lamp or with a pear-shaped lamp and, as desired, without the necessity of dismantling and disconnecting the socket cover from the rest of the fixture, the cover plate being connected to the body portion of the socket cover by a detachable joint.

LAMP SOCKET.—C. GANDELL, C/O Mrs. W. Nunn, 228 W. 40th St., New York, N. Y. The invention pertains more particularly to a method of constructing a lamp socket and the arrangement of the contact thereto. One of the objects is to construct a lamp socket in such manner that the lead wires are in actual contact with the contacts of the lamp globe when the latter is inserted therein, one of the lead wires forming a means for supporting the lamp globe within the socket.

LAMP FIXTURE AND SOCKET COVER.—W. B. LUK, C/O Electric Device Co., 479 Central Park West, New York, N. Y. An object of the invention is to provide a means whereby the socket is a simple and efficient manner connected to and detached from the fixture. A further object resides in the provision of means whereby the support for the socket, which is the fixture and the device for clamping the socket to the fixture, may be adapted for use in different sockets, without the necessity of changing the fixture.

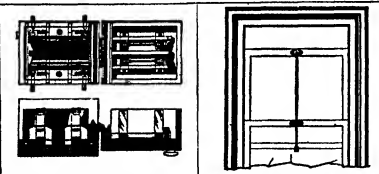


Fig. 2. The invention for which A. Berman was issued a patent, showing the spring mechanism.

REAR, C/O Mrs. Rein, Manual, Ohio. The general object of the invention is to provide an attachment adapted to be secured in position on the rear of the seat of a motor car and provided with means to form a constriction in the seat of the motor car, and by strapping covering means so constructed as to close the car's seat and thereby by well pressure instead of covering the seat by strapping the dirt over it, whereby the speed of travel is uniform regardless of the road condition of the latter.

Of General Interest

CLEANING FLUID FOR IMPREGNATING DIRTY CLOTHING AND THE LIKE.—P. WYNNER, 527 4th St., East, Haverhill, Mass. This cleaning fluid consists of one gallon coarse one-half gallon gasoline four ounces raw linseed oil and a few drops of oil of rose, mixed at a temperature of not less than 72° F. The cloth is immersed in the solution, the surplus solution removed, and the gasoline allowed to entirely evaporate; it is then ready for use either on various, leather or glass.

CYLINDRICAL STRUCTURE AND HOOKS THEREOF.—L. A. COOK and L. E. COOK, Aberdeen, S. D. The invention relates generally to cylindrical hook structures such as are used for hanging or holding the object being the provision of such a structure formed from blocks, whereby slight bending formation is brought about and a structure provided having a minimum of material, which will be weary light and capable of supporting internal and external pressure.

WINDOW-OPERATING DEVICE.—A. HETMAN, 220 13th Ave., Astoria, N. Y. An object of this invention is to provide means which will permit the raising and lowering of the upper sliding sash of a window without the necessity of using a cord or standing upon a chair or other support. A further object is to provide a rod with threaded connection for ready disconnection of the parts for removing the sash from the rod being in appearance, and efficient in use. (See Fig. 5.)

REMOVING DOG KENNEL.—C. CHAPMAN, 1200 Madison Ave., New York, N. Y. An object of the invention is to provide a dog kennel adapted to be mounted on the outside of a window sill of an apartment house which will permit the raising and lowering of the window frame in such manner as to be properly supported and protected from the weather, and the window frame which can be secured thereto at any time from the interior of the building. (See Fig. 6.)

RACK.—W. A. HANCOCK, 112 Market St., San Francisco, Cal. The object of the invention is to provide a rack designed for holding the blocks or tiles used in the form of "masonry" and the rack comprises an elongated block of material having an inclined front edge and a rear edge, the front edge being the ledge to a slightly inclined position, and the rear edge being the ledge to a rear edge, the rack being designed to be turned or rotated so as to move the tiles to the rear of the rack without disturbing the tiles already in place.

REMOVING DOG KENNEL.—C. CHAPMAN, 1200 Madison Ave., New York, N. Y. An object of the invention is to provide a dog kennel adapted to be mounted on the outside of a window sill of an apartment house which will permit the raising and lowering of the window frame in such manner as to be properly supported and protected from the weather, and the window frame which can be secured thereto at any time from the interior of the building. (See Fig. 6.)

MEANS FOR REMOVING STUMPS.—Y. YAN, 414 Main St., Newark, N. D. The invention has for its object the provision of a process whereby a stump is converted into charcoal before being removed. The stump is burnt to provide vertical air passages extending from the top of the stump to the ground, and the well incandescent combustion of the wood is held by lighting the wood and covering the stump with soil.

BRID COUPLING ATTACHMENT FOR LIGHTS.—C. C. FINANCE and M. L.

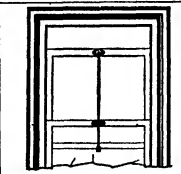


Fig. 3. The invention for which A. Berman was issued a patent, showing the spring mechanism.

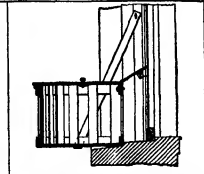


Fig. 4. Dog kennel, designed by C. Chapman, showing the spring mechanism.

— 30 —

Heating and Lighting

Machines and Mechanical Devices
ELECTRUM PIANO ACTION — G

AUTOMATIC DRILL PRESS—C. E. Cox, 610 Perk Ave. Rockford, Ill. Among the objects of this invention is to provide a device in which there is an arrangement for elevating and lowering the drill spindle, and a magazine in which a plurality of tools may be carried with means for bringing any desired tool into operative relation with the drill spindle, and means for locking the tool carrying mechanism in position for releasing it, et. al. will.

DRILLING MACHINE.—H. C. DAWSON, Shreveport, La. An important object of the invention is to provide a well drilling apparatus having a sub or suspended bearing arranged beneath the main bed and the rotary table of the machine, the bed being provided with suitable means for gripping a drill stem or pipe to hold the same against rotation independently of the rotary table.

SELF-CONTAINED BLOW OFF VALVE—O. H. Straup, Hubbell Mfg. Co. The invention relates generally to valves and more particularly to blow-off valves, the ob-

HAIR WAVING MACHINE.—J. M. HIGGINS, 1223 15th St., Sacramento, Calif. The particular object of the invention is to provide a machine that will enable a person to produce a Marcell wave on her own hair in a very short time, without the assistance of an attendant, and without the exercise of any particular skill. The device is simple and will produce the required wave in a few minutes.

PUMPING POWER—E. S. SIGAN, shipping engineer, Peabody, Mo. The invention relates more particularly to what is known in the oil well industry as pumping power. An important object is to provide a pumping power which employs an extremely heavy base into which is rotatably extended a main shaft surrounded by a suitable number of relatively stationary bearings so that the leverage cannot exert an excessive friction and thereby increase the lift of the bearings. (See Fig. 11)

BLEEDING APPARATUS.—R. F. SCHNEIDER, 125 Manhattan Ave., Jersey City, N. J. The invention relates to bleeding apparatus commonly used for extracting blood from the body for the purpose of making blood tests. The device includes a handle having a passage therein adapted to communicate with a hypodermic needle, a rigid nipple fixed to the handle and communicating with the passage and a flexible airtight coupling member adapted to hold the reduced breakable end of a vacuum tube within the plunger.

TONKILLATOME.—O. C. DANIELS, Oriental, N. C. The invention relates to surgical instruments adapted for use in severing and removing tissue, like portions of the body, and abnormal growths. An object is to provide an instrument which is simple in construction, adapted for convenient disassembly and replacement to permit of cleaning, or the sharpening of the cutting blade. A further object is to provide an instrument having relatively adjustable members adapted to grip the parts to be severed whereby the parts will be securely held in position, the device is adapted to be operated with one hand. (See Fig. 12.)

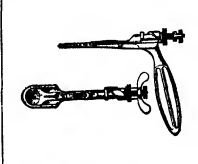


Fig. 12 Improved instrument for removing
tweeds, the invention of O. C. Daniels

STURTEVANT PRODUCTS

Acid-Proof Fans
 Air Washers
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 Engines—Steam and Gasoline
 Exhaustors
 Exhaust Hoods
 Fans
 Fuel Economizers
 Gas Blowers
 Gas Boilers
 Gear Transmissions
 Generating Sets—Steam and Gasoline
 Heaters
 Humidifiers
 Marine Gasoline Engines
 Marine Motors
 Mine Fans
 Motors—Alternating and Direct Current
 Propeller Fans
 Ventilating Sets
 Slow-Speed Planting Mill
 Exhaustors
 Steam Turbines
 Planing Mill Exhaustors
 Pressure Blowers
 Boilers
 Turbo Generating Sets
 Turbo Underdrift Blowers
 Unit Heaters
 Vacuum Cleaners
 Ventilating Roof

SYSTEMS

Air Conditioning
 Collecting and Conveying
 Drying
 Heating and Ventilating
 Power Apparatus
 Vacuum Cleaning
 Vapor Absorption

Sturtevant Draper at the plant of Audi & Wherry Co., printing job mfrs.

Sturtevant Hoisting and Ventilating System installation in Pettibone's Detroit

Sturtevant Forced Draft Fans at the Mill Gate Station of the United Electric Railway and Light Co.



Sturtevant Collecting and Lining System at Angus Shipyard of the C. P. R.

HARNESSING THE ATMOSPHERE

Air has been put to work in the service of mankind, in the same manner Watt conquered steam and Edison electricity.

Wherever men are collectively busy there is an air application that spells economy in human energy and operating costs. Have you ever thought of harnessing air to solve your problem?

Today you can call in Sturtevant Engineers on any air moving problem leading to conservation of manufacturing process, increased quantity and quality of output. From the smallest buffing wheel exhaust fan to the largest mine ventilating unit, Sturtevant equipment is designed to help industries with their air problems.

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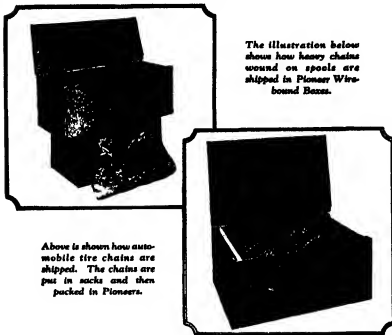
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of Yugoslavia. Most of the output is for peaceful purposes.—*Amer Mechanist*, 30 14, pp. 519-24.

A Coal By-Products Plant is being erected at Ford, Ontario, which will recover from the coal several useful elements. First, the coke, which will be burned in power stations, will be freed of sulphur. Then, the gas will be freed of the surplus gas, of which about 4,000 tonnes will be recovered per ton of coal. This will be used in the forging and heat treating operations required in the preparation of the steel for the motor cars. Third, the gas is freed of ammonia, which is one of the cheapest and most valuable forms of fertilizers known. Fourth, creosote, a chemical in greatest demand for timber preservation, will be recovered. Finally, the gas will be freed of oil and benzene, which will be recovered per ton of coal, and which contains all the properties of true kerosene and gasoline. Sixth, lubricating oil and grease—crude oil—will be recovered.

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A finer character than ordinary cast iron. Neither holds nor hard spots have been found in the world. The parts to be joined must be heated sufficiently to prevent the first deposited metal from freezing too rapidly and to allow the carbon time to dilute. At least 600° centigrade should be attained to start.—*Foundry Trade Jour.* 28, 846, p. 103.

Metals Produced in the Electric Furnace have, for different reasons, been considered to have more properties superior to those produced by other methods. Research and discussion in this direction suggest that we shall find results which will enable us to control and improve a metal for more pronounced mechanical efforts due to a knowledge of the electrical and magnetic phenomena. The nature of this control is based on the assumption that molecular structure and crystal growth are a hindrance due to electro-magnetic values. The regular flow of the electric current used below, an easy matter it appears that radical improvements in electric furnaces metals may be expected from the development of molecular electrical effects in the molten state.—*Canadian Chem. and Metallurgy* 7, 9, p. 198.

Stainless Steel was discovered by Mr. Harry Blavier in the course of research into the cause and cure of corrosion of the bars of large guns. The discovery had just been launched in a manufacturer's hands when the war broke out and during the war all available supplies of stainless steel were taken up by the fighting services very largely for armor armor plates. With this inevitable exception of its application to cut very few engineers are aware of its great value as an engineering material. Statements made to the effect that it is difficult to machine, unsuitable for highly stressed articles, unreliable as regards its stainless and rustless properties, all prohibitive in price need not be taken to act unless it has invariably been found out that when all the facts regarding the proper use of the material have been put in place before the steel manufacturer and the steel supplier has been treated in strict accordance with his instructions the results have been perfectly satisfactory. The rustless and stain free properties of the steel are to a certain extent disturbed by rough machining and it is always advisable to finish with a fine cut or better still by grinding. Polishing is an aid for the removal of the scale after heat treatment, being preferable to sand blasting.—*Foundry Trade Jour.* 28, 850, p. 151, 65.

Trend of Research in the Non Ferrous Metal Industry—The amount of engineering and scientific thought now applied in these industries is probably fifty times as great as in 1900 and ten times as great as in 1914. A recent survey revealed the fact that over sixty manufacturers within the non ferrous industries maintained research departments and laboratories in 1920. The use of pyrometers is increasing rapidly in all branches as well as that of testing instruments of all sorts—particularly the more scope. We find standards for products are now rapidly making headway especially by the splendid work of the American Society for Testing Materials and the U. S. Bureau of Standards. Another indication of the new research spirit is the increasing willingness and even, here on the part of individual companies to exchange information with others and to undertake cooperative research work.—*Industrial and Eng. Chem.* 15, 9, p. 860, 97.

Mining

The Soft Coal Lost in Mining equals more than one third of the total according to the United States Coal Commission. The principal causes of these losses are due to coal left on the top and bottom coals but in pillars coal lost under buildings, railroads and house-roads coal lost in preparation and handling and by other causes. Of these losses about 40 per cent is unavoidable, but nearly 60 per cent is considered as avoidable. The specific causes for these avoidable losses include improper methods of mining and careless engineering, careless dressing of the coal in the mine or at the tipple, losses due to excessive blasting, poor methods of transportation including cars that spill coal, too large pieces of coal due to leaving all time to keep the surface intact where back filling methods might be employed. The greatest loss in mining is in room entry and panel pillars, this loss varying from 5 to 45 per cent, of which from 3 to 35 per cent is avoidable. Sometimes pillar-drawing is done more or less carefully, and some containing from 30 to 100 tons are left untouched.—*Report of U. S. Coal Com.* Sept. 1923.



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The Automatic Centrifugal Pumping Outfit no doubt will revolutionize mine pumping. In the Minnesota coal field it is asserted that an average of about two tons of water is pumped from the mines per ton of coal mined, while in the anthracite field the ratio is about eleven tons to one! In some places the figures run as high as fifty to one! The idea of developing an automatic centrifugal pumping outfit was first suggested in May, 1923, and tried out with success in June of the same year. Since that date many automatic centrifugal pumping outfits have been laid out and ordered and some are already in operation. The new system makes possible remote control of the pumps, requires labor costs for pump operation, simplifies keeping a pump in order during temporary stoppages, and in the event of strikes makes possible the operation of a large number of pumps with only a small amount of on-site inspection.—Coal Age, 34 1/2, p. 388

Extensive Underground Temperatures in the mines of Butte, Montana, the world's largest mining camp, have been indicated, in some instances, as much as 10 to 15 degrees, through the application of sensitive ventilation methods, according to Bulletin 914 issued by the Bureau of Mines which describes the investigations of two sections of the Department of the Interior. Lower mine workings with rock temperatures of more than 120 degrees previously worked able have been converted into comfortable working places. Butte mining companies now believe that in some their ore bodies reach a depth of 3000 feet or over, with rock temperatures of 110 to 120 degrees, they will be able to obtain for such deep workings an atmosphere that will allow safe, profitable and efficient work. The mining companies of the Butte district have recently made great progress in ventilation betterment. The dust situation has been largely eliminated by the adoption of wet drills for practically all drilling by the introduction of water lines for spraying to practically all working faces in many mines and by increasing the flow of air to working places.—The American Engineer and Architect, 13 5 p. 8-9

Carbon Monoxide in Mines, most insidious of deadly of poisonous gases, may be detected and means have been found by which it is possible to detect within three minutes the extent to which a person has been affected by carbon monoxide gas through the extent of poison saturation of the blood. Formerly it took approximately from 24 to 48 hours before diagnosis could be made of such cases either in hospitals or in well-equipped laboratories with the services of a well skilled organic chemist. The test is effected through a simple and inexpensive instrument which may be carried in the pocket and which requires no special training for its operation. Many human lives are expected to be saved by the general adoption of this method of detecting gas poisoning, particularly in the mining industry as well as in other fields where drugged gases are a menace. With this quick method of diagnosis it is possible to institute promptly the proper emergency treatment. Diagnosis of the possible exposure of citizens in all walks of life to its deadly influence the new instrument for detecting it in the blood is expected to be in universal use among the physicians within the near future.—The American Engineer and Architect, 13 5, p. 9

Two Important Developments have recently been made in rendering the coarser treats from the froth flotation system of coal washing more suitable for industrial purposes. These concentrates are finely divided coal particles mixed with a large quantity of water and the concentrates must be separated from the water with which they are originally in such close association. The first method consists in agitating the pulp and separating it. Oil or is added to coat the particles and make them floatable together, after which they are separated from the water by draining or filtering, without being compressed into blocks or briquets. In the second process the pulp of coal and water is agitated with a blading agent consisting of pitch which contains asphaltum or phosphorus so as to coat and floatable the particles as in the first method. On introducing the pulp into a press and subjecting it to a pressure of two tons per square inch, an excellent briquet is produced, substantially free from moisture. The briquets are hard and durable, and become harder with time, and it is also found that the washability variations out of them.—Coal Age, 34 1/2, p. 377-78

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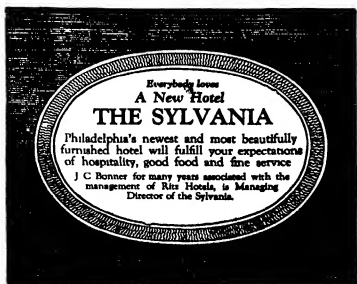
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With Fire and Fraud

(Continued from page 485)

quipped himself about a conflagration in which the innocent old man himself destroyed. It is pleasant to believe that the burglar and his son were both sent to prison for long terms. But other thins, other acts and other victims.

It is manifestly impossible to make a list of all the mechanical and other devices used for producing profitable fraud. Had the various insurance companies the credit accounts of the police large collections of all such instruments and mechanisms there would be material for a museum. The Bureau of Ocean Fisheries in the New York Police Department must alone have had enough stolen tools to fill a great gallery.

Ordinarily sooner or later come to realize the futility of mechanical attack. Bodolady has too many weapons for defense too many officers for detection, too many inventors at work. Naturally the cleverest lawbreaker turns wherever he can to some scheme some mental fabrication to take the place of a machine. Accordingly the arena profusion he has developed a technique of fire setting (let may be undertaken) from the story of Mr. Hyman Marks general merchant and entrepreneur in Mass.

A year ago Mr. Marks opened a drygoods and notions store at Blank, Wyo. He also opened communication with eastern jobbers told them what an honest man he was, promised payments at a stated time and on time in each letter on order for goods. Many of the credit men of the firms address him were eager to capture a little new business and took their chance seeing that the new man a reputation was small. Hyman Mr. Marks got a good deal of merchandise on credit. To him in all honor he paid for it at the end of thirty days and continued to do so. He was a somewhat larger order which the jobber's train filled in each case. Marks had established himself as honest and good pay.

When time came for the second payment it too was made promptly and a third as it still larger order was sent along with the remittance. I suppose I need not go further into the details of this modern method of working up a credit.

Marks added a thrill to the old game by opening a second store at Where Wyo. He informed all of his jobbers of this move saying that business was good but that he would improve it by opening a second lot to reach a new body of buyers. How ever he intended to do all buying through his first and main store. So setting he enclosed a very large order. The jobbers saw what Marks had written set him down as an intelligent and progressive man—and sent him the goods.

Now the fun began. Marks took the merchandise out of the name at his main store in Blank, repacked the boxes with oil and steel consider and large stones, and layed these false in his place in the store. At the same time he made a display of real merchandise and sent it to Where Wyo. and took out \$15,000 worth of fire insurance. As for not the policy had been written and the premium had been paid, he was ready to receive.

Marks slipped back to his Blank store wherever valuable stuff there had been at Where. Then he secretly stripped stores at Blank by removing his goods a little at a time and securing them in Denver. Just before Christmas, both stores were practically empty except for odds and ends of poor stuff and a great many empty boxes.

On a latter winter night when it was within the frames could work with the greatest difficulty the store at Where was burnt suddenly into flames and the store at Blank began the fire future could get into trouble. Indeed they had all their stock due to keep the blame from spreading and on gratified themselves on saving their own.

While this was happening Mr. Marks was of course in Blank. He collected his insurance, went over the fire, took the policy, enough to drive his son, fast the books at the Blank store to show that the loss of the insurance money to relatives and friends who had lost him much on notes and then closed the doors of his store in Denver. Creditors swarmed down on him but could find neither goods nor any fault in his statements.

Then Mr. Marks disappeared. Two weeks later a notice was read through which made a story in one of the principal business journals of Denver. It was a story of a man who had been in the store for years and prepared to close in Denver. (Continued on page 487)

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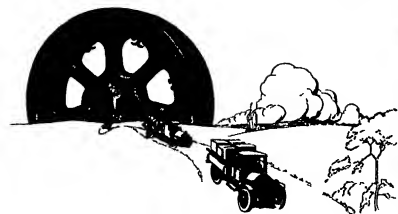
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denon advised above, is that of immortality. I have already given one instance of this in her inability to stick to one story about the location of the writings in the past. Equally unsatisfactory was the matter of "soft" colors. We could get no more reliable statement than this. She was certain that yellow was not "soft," but in the next breath indicated that the real objection to it was that a message written in it would not be sufficiently legible. This, by the way, is correct; the philatelist finds it often impossible to distinguish between two minor varieties of a rubber or even of an orange stamp. On the heads of the settings, it would appear that "soft" means "dead" colors of any other tone were ignored by the medium whenever possible. A test which she applied at the first sitting only was to crush the petals and note whether a stain remained on her finger; if it did, the color was satisfactory.

The medium was a tremendous talker. She had several anecdotes which she told repeatedly, and at every opportunity, in season and out, she told us at length of the wonderful things she had done at other times and places. This, by the way, was another marked feature of our sittings of last May, with "Mr. X," that at the time we conducted a parlor, "when we weren't looking," to define the conditions under which these marvels were produced. Mrs. X, incidentally, is acquainted with Mr. X and did what she could to make us wonder whether we had not made a mistake in his case. Of no bearing on the case was the fact that we had not made it significant in retrospect.

The medium's fluent conversation, in itself, would perhaps not have been objectionable, she could do something, if she be genuine, to "get out of herself" and to destroy self-consciousness. But the manner of her talking was very objectionable. Again and again, when Dr. Pringle, Dr. Carrington, Mr. Loeferbauer or I was watching her hands or engaged in some other definite bit of observation, she would deliberately address her next remark to this observer, in such a way that his every instinct was to transfer his gaze to her then for the purpose of the observation. This looked altogether too much like a trick.

The judgment of one inclined to accept the mediumism, a priori, no genuine would have been that the three initial failures were due to the lady's inability to relax mentally and get out of herself. Her mind was extremely active, and she led the conversation rather than following it or letting it run its course unhindered. Often Dr. Carrington pointed this out to her, in response to her complaint that she couldn't relax, couldn't forget herself. She remarked the general tension of the atmosphere—a complaint that was probably justified the first day, but hardly on later occasions. On the other side of the picture the others were "unconscious," after the second and third sittings, that Mrs. T's whole attitude had been extremely purposeful—that of one who has no slightest apprehension of getting results. This was not noted at the first session—perhaps because the necessity for getting away with some of the cards lay very interested. At a fifth, and unsuccessful, sitting held in our office again on the 18th, her lack of interest and her evident knowledge that nothing was to happen were flagrant.

Mrs. X has, at home, an extraordinary collection of documents attesting the faith in her possessions felt by the dignitaries she brought a portfolio of these with her, and, in spite of our explanation that it hadn't the slightest bearing on our consideration of her case, insisted upon leaving it with us and upon our reading its contents. Equally, and against the same recommendations, she insisted upon telling us about several occasions on which she had been charged with fraud, and explaining these charges away. In particular, the national organization of Spiritualists has registered her, bringing exactly the same accusation that we bring, and she used up a lot of time informing us of this, and giving the version of the affair. There was also an extended narrative of some horrible experience which she had had at the hands of a committee of magicians, which she insisted upon giving us twice, in great detail.

As we went along, Mrs. X devoted more and more of her power to expounding her appreciation of the eminently courteous and proper treatment which she was getting at our hands. We, of course, went out of our way to make this statement line up with the facts. We met the lady one afternoon our examination of the Haydel results had been completed. She was extraordinarily well pleased with herself, and with us, she had

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without any message. The last pattern on lock is quite foreign to the letters of nationalism, patriotism or any other, the only flowers in use on this day, and the microscope makes it look very much as though brushed on, like the writing.

The fifth card, a picture of which is cropped out, carries a gold message from Edna, with her signature: "We who love you are doing all we can to establish this truth." This, I think, makes it fair to criticize the message, per se. In telling of the wonderful things which the "medium" was not looking, the medium gave us to understand that her messages were usually evidential, that they applied to people in the audience often strangers to her, that they were recognized by these people, that the names and sometimes the very signature of the communicators were verified, etc. Nothing like this, it will be noted, occurred in our program. All five of our messages were platitudinous attitudes of the worst sort. There is nothing whatever in them worth to contradict the assumption that they were prepared in advance.

To the fourth message a bit of romance adheres. One of the medium's adherents carries this name. The signer lived in Sleek Inn when Mrs. Y. knew him, and she informed us that she planned to look him up. When the card came bearing his signature, there was much speculation. Mrs. Y. called his residence that evening, according to her statement of next morning, and was informed that he had died several months previously. We were inclined to question the sequence of these incidents.

The medium has made several public or semi public statements since returning to her home, and in the eye of one who knows all the facts of the sittings and of our dealings with Mrs. Y. these statements merit severely just as an instance, she is quoted as having told her congregation that, on arrival at our office for the first sitting, she was led into the presence of fifteen men smoking cigars, and forced to go through the motion in an atmosphere laden with this smoke. The slender basis of fact for this yarn is that, while the group was waiting for the seance, one gentleman was smoking a cigar. Mrs. Y. asked me to stop him, and I did, after which, the commencement of the sitting was delayed for twenty minutes or more, with the windows wide open for ventilation throughout this interval. She also seeks to make capital of the claim that she was "fused," by us, to undergo denodation and exorcism by a group of strange women. The fact, of course, is that we searched her only when she insisted, and should not have searched her at all had she not insisted. She would do better to stick to facts.

One more point, of some delicacy, must be touched upon in numerous other instances, investigators who have brought criticism of fraud against mediums have had their findings flung in their teeth, the retort being always that the facts are correct, but that the fraud which they imply was committed by the investigators themselves.

I am not drawing upon a discarded imagination when I say that we shall be accused in this charge. It has already been made from several quarters. Those who make it, of course, either under the disadvantage of not having all the facts in their possession, and hence they are apt to single out as their culprit some one of the sitters who never handled the cards, and hence never had opportunity to subvert. But what is a little detail like that, when there is a medium to defend against charges? What matters it to these people that the subverter would have had to be in league with the medium, in order to exorcise his will with her very dramatic behavior at the critical moment? What matters anything, say that another medium has been discovered and must be rehabilitated?

The SCIENTIFIC AMERICAN had anticipated this defense, however, and had done what we could to meet it in advance. In the most elaborate manner where the charge of fraud was turned against the investigation, much was made of the fact, they established, that a number of people in the confidence of the Committee had more or less free access to the documents. We declined to avoid the error, at least. Accordingly, at no time before or during the seance was any of the cards out of my immediate possession, nor when some of them were sent out to be critiqued, when the medium was usually working with them, and when once or twice she herself handed them to Dr. Cunningham to be critiqued, rather than to me. The latter action was actually outside the permitted-upon procedure, and could not have been dis-

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